EXHIBIT OP-1

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/031,125	07/10/2018	Philippe SALAH	N&P-51423	3171

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EXAMINER	
AZARIAN, SEYED H	

ART UNIT	PAPER NUMBER
2667	

NOTIFICATION DATE	DELIVERY MODE
01/01/2021	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patdoc@cooperlegalgroup.com

PTOL-90A (Rev. 04/07)

Office Action Summary	**Application No.** 16/031,125	**Applicant(s)** SALAH et al.	
	Examiner SEYED H AZARIAN	**Art Unit** 2667	**AIA (FITF) Status** Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 12/2/2020.
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-8,10,14-15 and 17-21 is/are pending in the application.
5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-6,10,14-15 and 17-21 is/are rejected.

8) ☑ Claim(s) 7-8 is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 7/10/2018 is/are: a)☑ accepted or b)☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
Certified copies:
a)☑ All b)☐ Some** c)☐ None of the:
1.☑ Certified copies of the priority documents have been received.
2.☐ Certified copies of the priority documents have been received in Application No. _____.
3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b)
Paper No(s)/Mail Date ______.

3) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date ______.

4) ☐ Other: ______.

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 12/2/2020 has been entered.

RESPONSE TO AMENDMENT

2. Based on applicant's amendment filed on 12/2/2020, see page 2 through 10, of the remark, with respect to cancellation of claims 9, 11, 12, 13, 16, and amended claims 1 and new claims 17, 18, 19, 20 and 21, have been fully considered and are moot in view of the new ground (s) of rejection as necessitated by applicant's amendment is made in view of Borovinskih et al (Pub. No: U.S. 2017/0049311 A1).

Contrary to the applicant's assertion, as he traverses, regarding limitations of amended claim 1, that Kuo does not teach or suggest "an analysis image being in colors".

Examiner indicates, that Kuo discloses (see claim 1, also page 20, paragraphs, [0249] and [0252], in a further embodiment, a maximum difficulty rating may be pre-designated for a particular user (for example, the doctor or clinician) such that the predefined treatment goals displayed as available to that user may include only those treatment goals up to the maximum

pre-designated difficulty rating. In one embodiment, the difficulty ratings may be associated with an alphanumeric scale, a graphical scale (including icons, “colors”, images and the like), an auditory scale, or one or more combined scale for ease of use. Referring back to step 2930, at (3B) of FIG. 29, in one embodiment, the feedback from the query function provided to the user can also include rating of treatment goals once an initial assessment is created. In such embodiment, an assessment of treatment difficulty is done based on the combination of the patient's initial dental condition and selected goal. For example, a treatment difficulty indicator of 1, 2, or 3 may be attributed to a given initial dental condition/treatment goal combination, whereby "1" is a difficulty indicator of an "easy" combination, "2" is a difficulty indicator of a "moderate" combination, and "3" is a difficulty indicator of a "severe" combination. Difficulty indicators may also be “associated with colors”, symbols, and alphanumeric characters.

Contrary to the applicant’s assertion, as he traverses, regarding limitations of amended claim 1, that Kuo does not teach or suggest “analysis image being performed with a cellphone”.

Examiner indicates, that Kuo discloses, (see page 16, paragraph, [0206] FIG. 28 illustrates a process 2800 for identifying a dentition problem or condition of a patient. The process 2800 is discussed more fully in conjunction with FIGS. 16-27. At step 2801, the user starts by entering identification information such as doctor and patient name, in addition to patient chief concern(s) (FIG. 16). In one embodiment, this comparison may be performed by the central server 1109 (FIG. 11) based on information received, for example, from the terminal 1101, and/or based on stored information retrieved from the data storage unit 1107. This and other related transactions in the process may be performed over a data network such as the internet via a secure connection. The user then selects one of two user interfaces to input the patient's dental condition. The preferred method for the novice user is the visual-user interface (FIG. 17-22)

shown as step 2802. The advanced user will likely prefer the alternative user interface (FIG. 25) illustrated as step 2803).

But does not explicitly state, limitation of claim "image is acquired with a cell phone".

On the other hand "Borovinskih", in the same field of "photograph-based assessment of dental treatments and procedures", teaches (page 4, paragraph, [0036] FIGS. 5A-D graphically illustrate the treatment-monitoring method to which the current document is, in part, directed. As shown in FIG. 5A, at a particular current point in time, t.sub.82, during a dental patient's treatment or procedure, represented in FIG. 5A by vertical arrow 502, a dental practitioner examines the patient and takes a number n of two-dimensional pictures of the patient's teeth 504. Alternatively, in certain implementations, the two-dimensional pictures may be taken by a patient's friend or relative, or even the patient, using a camera timer or smart-phone features that facilitate acquisition of images of a user. In the current example, n is equal to 3. In general, each photograph or subset of the photographs represents a certain, standard view or image type. A dental practitioner or other person is provided with instructions for capturing an image of a particular standard view or type. As shown in FIG. 5B, once the practitioner has submitted these two-dimensional images, along with patient information, an indication of the time that the two-dimensional images were captured, and other such information, the treatment-monitoring system, to which the current document is, in part, directed, determines camera parameters for virtual cameras 506-508, the orientations and positions of which most likely correspond to the camera parameters of the dental practitioner's camera at the points in time at which each of the corresponding n two-dimensional pictures, 510-512, respectively, were captured by the dental practitioner or other person).

Therefore, it would have been obvious to one having ordinary skill in the art at the time

the invention was made to modify the Kuo invention according to the teaching of Borovinskih because to combine "the central server to be configured to communicate with the terminal and data storage unit to access software stored in the data storage unit that may be performed over the internet that is taught by the Kuo invention according to the teaching taught by Borovinskih, using a smart phone and camera to capture dental images would provide for an improved method and system of acquiring and transmitting dental images, information, and messages captured with a camera in a smart (cell) phone and sent via the internet.

Contrary to the applicant's assertion, as he traverses, regarding limitations of amended claims 1 and 15, that Kuo does not teach or suggest "the submission of an image to a neural network, or determining values of a tooth attribute or an image attribute".

Examiner indicates, that Kuo clearly discloses (pages 4-5, paragraphs, [0074-0075] in one embodiment, data driven analyzers may be applied. These data driven analyzers may incorporate a number of models such as parametric statistical models, non-parametric statistical models, clustering models, nearest neighbor models, regression methods, and engineered (artificial) neural networks. Prior to operation, data driven analyzers or models are built using one or more training sessions. The data used to build the analyzer or model in these sessions are typically referred to as training data. As data driven analyzers are developed by examining only training examples, the selection of the training data can significantly affect the accuracy and the learning speed of the data driven analyzer. One approach used heretofore generates a separate data set referred to as a test set for training purposes. The test set is used to avoid overfitting the model or analyzer to the training data. Overfitting refers to the situation where the analyzer has memorized the training data so well that it fails to fit or categorize unseen data. Typically, during the construction of the analyzer or model, the analyzer's performance is tested against the test set.

The selection of the analyzer or model parameters is performed iteratively until the performance of the analyzer in classifying the test set reaches an optimal point. At this point, the training process is completed. An alternative to using an independent training and test set is to use a methodology called cross-validation. Cross-validation can be used to determine parameter values for a parametric analyzer or model for a non-parametric analyzer. In cross-validation, a single training data set is selected. Next, a number of different analyzers or models are built by presenting different parts of the training data as test sets to the analyzers in an iterative process. The parameter or model structure is then determined on the basis of the combined performance of all models or analyzers. Under the cross-validation approach, the analyzer or model is typically retrained with data using the determined optimal model structure. In one embodiment, the data mining software 3 (FIG. 1A) can be a "spider" or "crawler" to grab data on the database 2 (FIG. 1A) for indexing. In one embodiment, clustering operations are performed to detect patterns in the data. In another embodiment, a neural network is used to recognize each pattern as the neural network is quite robust at recognizing dental treatment patterns. Once the treatment features have been characterized, the neural network then compares the input dental information with stored templates of treatment vocabulary known by the neural network recognizer, among others. The recognition models can include a Hidden Markov Model (HMM), a dynamic programming model, a neural network, a fuzzy logic, or a template matcher, among others. These models may be used singly or in combination.

Finally, page 5, paragraphs, [0083] The HMM template has a number of states, each having a discrete value. However, as treatment pattern features may have a dynamic pattern in contrast to a single value, the addition of a neural network at the front end of the HMM in an embodiment provides the capability of representing states with dynamic values. The input layer

of the neural network comprises input neurons. The outputs of the input layer are distributed to all neurons in the middle layer. Similarly, the outputs of the middle layer are distributed to all output neurons, which output neurons correspond one-to one with internal states of the HMM. However, each output has transition probabilities to itself or to other outputs, thus forming a modified HMM. Each state of the thus formed HMM is capable of responding to a particular dynamic signal, resulting in a more robust HMM. Alternatively, the neural network can be used alone without resorting to the transition probabilities of the HMM architecture).

Claim Objections

3. Claim 10 is objected to because of the following informalities: The numbering of claims is not in accordance with 37 CFR 1.126 which requires the original numbering of the claims to be preserved throughout the prosecution. The claim 10 is dependent on claim 9, which has been canceled. Appropriate correction is required.

DETAILED ACTION

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1-6, 10, 14-15 and new claims 17-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over as being anticipated by Kuo (U.S. Pub No: 2015/0132708 A1) in view of

Borovinskih et al (Pub. No: U.S. 2017/0049311 A1).

Regarding claim 1, Kuo discloses a method for analyzing an image, called "analysis image", of a dental arch of a patient (see the abstract, also pages 3-5, paragraphs, [0060-0068] FIG. 1A shows one exemplary dental data mining system. In this system, dental treatment and outcome data sets 1 are stored in a database or information warehouse 2. The data is extracted by data mining software 3 that generates results 4. The data mining software can interrogate the information captured and/or updated in the database 2 and can generate an output data stream correlating a patient tooth problem with a dental appliance solution. Note that the output of the data mining software can be most advantageously, self-reflexively, fed as a subsequent input to at least the database and the data mining correlation algorithm. The result of the data mining system of FIG. 1A is used for defining appliance configurations or changes to appliance configurations for incrementally moving teeth. The tooth movements will be those normally associated with orthodontic treatment, including translation in all three orthogonal directions, rotation of the tooth centerline in the two orthogonal directions with rotational axes perpendicular to a vertical centerline ("root angulation" and "torque"), as well as rotation of the tooth centerline in the orthodontic direction with an axis parallel to the vertical centerline ("pure rotation"). In one embodiment, the data mining system captures the 3-D treatment planned movement, the start position and the final achieved dental position. The system compares the outcome to the plan, and the outcome can be achieved using any treatment methodology including removable appliances as well as fixed appliances such as orthodontic brackets and wires, or even other dental treatment such as comparing achieved to plan for orthognathic surgery, periodontics, restorative, among others. In one embodiment, a teeth superimposition tool is used to match treatment files of each arch scan. The refinement scan is superimposed over the

initial one to arrive at a match based upon tooth anatomy and tooth coordinate system. After teeth in the two arches are matched, the superimposition tool asks for a reference in order to relate the upper arch to the lower arch. When the option "statistical filtering" is selected, the superimposition tool measures the amount of movement for each tooth by first eliminating as reference the ones that move (determined by the difference in position between the current stage and the previous one) more than one standard deviation either above or below the mean of movement of all teeth. The remaining teeth are then selected as reference to measure movement of each tooth. FIG. 1B shows an analysis of the performance of one or more dental appliances. "Achieved" movement is plotted against "Goal" movement in scatter graphs, and trend lines are generated. Scatter graphs are shown to demonstrate where all "scattered" data points are, and trend lines are generated to show the performance of the dental appliances. In one embodiment, trend lines are selected to be linear (they can be curvilinear); thus trend lines present as the "best fit" straight lines for all "scattered" data. The performance of the Aligners is represented as the slope of a trend line. The Y axis intercept models the incidental movement that occurs when wearing the Aligners. Predictability is measured by R.sup.2 that is obtained from a regression computation of "Achieved" and "Goal" data.

Also page 3, paragraphs, [0068-0069], in one embodiment, clinical parameters in steps such as 170 (FIG. 2A) and 232 (FIG. 2B) are made more precise by allowing for the statistical deviation of targeted from actual tooth position. For example, a subsequent movement target might be reduced because of a large calculated probability of currently targeted tooth movement not having been achieved adequately, with the result that there is a high probability the subsequent movement stage will need to complete work intended for an earlier stage. Similarly, targeted movement might overshoot desired positions especially in earlier stages so that expected

actual movement is better controlled. This embodiment sacrifices the goal of minimizing round trip time in favor of achieving a higher probability of targeted end-stage outcome. This methodology is accomplished within treatment plans specific to clusters of similar patient cases. Table 1 shows grouping of teeth in one embodiment. The sign convention of tooth movements is indicated in Table 2. Different tooth movements of the selected 60 arches were demonstrated in Table 3 with performance sorted by descending order. The appliance performance can be broken into 4 separate groups: high (79-85%), average (60-68%), below average (52-55%), and inadequate (24-47%). Table 4 shows ranking of movement predictability. Predictability is broken into 3 groups: highly predictable (0.76-0.82), predictable (0.43-0.63) and unpredictable (0.10-0.30). For the particular set of data, for example, the findings are as follows: Incisor intrusion, and anterior intrusion performance are high. The range for incisor intrusion is about 1.7 mm, and for anterior intrusion is about 1.7 mm. These movements are highly predictable);

method in which the analysis image is submitted to a neural network, in order to determine at least value of a tooth attribute relating to a tooth represented on the analysis image, the analysis image being a photograph or an image taken from a film, (see pages 3-5, paragraphs, [0060-0068] FIG. 1A shows one exemplary dental data mining system. In this system, dental treatment and outcome data sets 1 are stored in a database or information warehouse 2. The data is extracted by data mining software 3 that generates results 4. The data mining software can interrogate the information captured and/or updated in the database 2 and can generate an output data stream correlating a patient tooth problem with a dental appliance solution. Note that the output of the data mining software can be most advantageously, self-reflexively, fed as a subsequent input to at least the database and the data mining correlation algorithm. The result of the data mining system of FIG. 1A is used for defining appliance configurations or changes to

appliance configurations for incrementally moving teeth. The tooth movements will be those normally associated with orthodontic treatment, including translation in all three orthogonal directions, rotation of the tooth centerline in the two orthogonal directions with rotational axes perpendicular to a vertical centerline ("root angulation" and "torque"), as well as rotation of the tooth centerline in the orthodontic direction with an axis parallel to the vertical centerline ("pure rotation"). In one embodiment, the data mining system captures the 3-D treatment planned movement, the start position and the final achieved dental position. The system compares the outcome to the plan, and the outcome can be achieved using any treatment methodology including removable appliances as well as fixed appliances such as orthodontic brackets and wires, or even other dental treatment such as comparing achieved to plan for orthognathic surgery, periodontics, and restorative, among others. In one embodiment, a teeth superimposition tool is used to match treatment files of each arch scan. The refinement scan is superimposed over the initial one to arrive at a match based upon tooth anatomy and tooth coordinate system. After teeth in the two arches are matched, the superimposition tool asks for a reference in order to relate the upper arch to the lower arch. When the option "statistical filtering" is selected, the superimposition tool measures the amount of movement for each tooth by first eliminating as reference the ones that move (determined by the difference in position between the current stage and the previous one) more than one standard deviation either above or below the mean of movement of all teeth. The remaining teeth are then selected as reference to measure movement of each tooth. FIG. 1B shows an analysis of the performance of one or more dental appliances. "Achieved" movement is plotted against "Goal" movement in scatter graphs, and trend lines are generated. Scatter graphs are shown to demonstrate where all "scattered" data points are, and trend lines are generated to show the performance of the dental appliances. In one embodiment,

trend lines are selected to be linear (they can be curvilinear); thus trend lines present as the "best fit" straight lines for all "scattered" data. The performance of the Aligners is represented as the slope of a trend line. The Y axis intercept models the incidental movement that occurs when wearing the Aligners. Predictability is measured by R.sup.2 that is obtained from a regression computation of "Achieved" and "Goal" data.

Also page 3, paragraphs, [0068-0069], in one embodiment, clinical parameters in steps such as 170 (FIG. 2A) and 232 (FIG. 2B) are made more precise by allowing for the statistical deviation of targeted from actual tooth position. For example, a subsequent movement target might be reduced because of a large calculated probability of currently targeted tooth movement not having been achieved adequately, with the result that there is a high probability the subsequent movement stage will need to complete work intended for an earlier stage. Similarly, targeted movement might overshoot desired positions especially in earlier stages so that expected actual movement is better controlled. This embodiment sacrifices the goal of minimizing round trip time in favor of achieving a higher probability of targeted end-stage outcome. This methodology is accomplished within treatment plans specific to clusters of similar patient cases. Table 1 shows grouping of teeth in one embodiment. The sign convention of tooth movements is indicated in Table 2. Different tooth movements of the selected 60 arches were demonstrated in Table 3 with performance sorted by descending order. The appliance performance can be broken into 4 separate groups: high (79-85%), average (60-68%), below average (52-55%), and inadequate (24-47%). Table 4 shows ranking of movement predictability. Predictability is broken into 3 groups: highly predictable (0.76-0.82), predictable (0.43-0.63) and unpredictable (0.10-0.30). For the particular set of data, for example, the findings are as follows: Incisor intrusion, and anterior intrusion performance are high. The range for incisor intrusion is about 1.7 mm, and

for anterior intrusion is about 1.7 mm. These movements are highly predictable.

Also page 4, paragraphs, [0074-0075] in one embodiment, data driven analyzers may be applied. These data driven analyzers may incorporate a number of models such as parametric statistical models, non-parametric statistical models, clustering models, nearest neighbor models, regression methods, and engineered (artificial) neural networks. Prior to operation, data driven analyzers or models are built using one or more training sessions. The data used to build the analyzer or model in these sessions are typically referred to as training data. As data driven analyzers are developed by examining only training examples, the selection of the training data can significantly affect the accuracy and the learning speed of the data driven analyzer. One approach used heretofore generates a separate data set referred to as a test set for training purposes. The test set is used to avoid overfitting the model or analyzer to the training data. Overfitting refers to the situation where the analyzer has memorized the training data so well that it fails to fit or categorize unseen data. Typically, during the construction of the analyzer or model, the analyzer's performance is tested against the test set. The selection of the analyzer or model parameters is performed iteratively until the performance of the analyzer in classifying the test set reaches an optimal point. At this point, the training process is completed. An alternative to using an independent training and test set is to use a methodology called cross-validation. Cross-validation can be used to determine parameter values for a parametric analyzer or model for a non-parametric analyzer. In cross-validation, a single training data set is selected. Next, a number of different analyzers or models are built by presenting different parts of the training data as test sets to the analyzers in an iterative process. The parameter or model structure is then determined on the basis of the combined performance of all models or analyzers. Under the cross-validation approach, the analyzer or model is typically retrained with data using the

determined optimal model structure.

Also page 5, paragraph [0075], in one embodiment, the data mining software 3 (FIG. 1A) can be a "spider" or "crawler" to grab data on the database 2 (FIG. 1A) for indexing. In one embodiment, clustering operations are performed to detect patterns in the data. In another embodiment, a neural network is used to recognize each pattern as the neural network is quite robust at recognizing dental treatment patterns. Once the treatment features have been characterized, the neural network then compares the input dental information with stored templates of treatment vocabulary known by the neural network recognizer, among others. The recognition models can include a Hidden Markov Model (HMM), a dynamic programming model, a neural network, a fuzzy logic, or a template matcher, among others. These models may be used singly or in combination.

Also page 7, paragraph, [0102] as an initial step, a mold or a scan of patient's teeth or mouth tissue is acquired (110). This step generally involves taking casts of the patient's teeth and gums, and may in addition or alternately involve taking wax bites, direct contact scanning, x-ray imaging, tomographic imaging, sonographic imaging, and other techniques for obtaining information about the position and structure of the teeth, jaws, gums and other orthodontically relevant tissue. From the data so obtained, a digital data set is derived that represents the initial (that is, pretreatment) arrangement of the patient's teeth and other tissues).

Finally, page 5, paragraphs, [0083] The HMM template has a number of states, each having a discrete value. However, as treatment pattern features may have a dynamic pattern in contrast to a single value, the addition of a neural network at the front end of the HMM in an embodiment provides the capability of representing states with dynamic values. The input layer of the neural network comprises input neurons. The outputs of the input layer are distributed to

all neurons in the middle layer. Similarly, the outputs of the middle layer are distributed to all output neurons, which output neurons correspond one-to one with internal states of the HMM. However, each output has transition probabilities to itself or to other outputs, thus forming a modified HMM. Each state of the thus formed HMM is capable of responding to a particular dynamic signal, resulting in a more robust HMM. Alternatively, the neural network can be used alone without resorting to the transition probabilities of the HMM architecture);

the analysis image being in color (see claim 1, also page 20, paragraphs, [0249] and [0252], in a further embodiment, a maximum difficulty rating may be pre-designated for a particular user (for example, the doctor or clinician) such that the predefined treatment goals displayed as available to that user may include only those treatment goals up to the maximum pre-designated difficulty rating. In one embodiment, the difficulty ratings may be associated with an alphanumeric scale, a graphical scale (including icons, colors, images and the like), an auditory scale, or one or more combined scale for ease of use. Referring back to step 2930, at (3B) of FIG. 29, in one embodiment, the feedback from the query function provided to the user can also include rating of treatment goals once an initial assessment is created. In such embodiment, an assessment of treatment difficulty is done based on the combination of the patient's initial dental condition and selected goal. For example, a treatment difficulty indicator of 1, 2, or 3 may be attributed to a given initial dental condition/treatment goal combination, whereby "1" is a difficulty indicator of an "easy" combination, "2" is a difficulty indicator of a "moderate" combination, and "3" is a difficulty indicator of a "severe" combination. Difficulty indicators may also be “associated with colors”, symbols, and alphanumeric characters);

However regarding limitation of amended claim, “the analysis image being performed with a cellphone”, Kuo discloses (see page 16, paragraph, [0206] FIG. 28 illustrates a process

2800 for identifying a dentition problem or condition of a patient. The process 2800 is discussed more fully in conjunction with FIGS. 16-27. At step 2801, the user starts by entering identification information such as doctor and patient name, in addition to patient chief concern(s) (FIG. 16). In one embodiment, this comparison may be performed by the central server 1109 (FIG. 11) based on information received, for example, from the terminal 1101, and/or based on stored information retrieved from the data storage unit 1107. This and other related transactions in the process may be performed over a data network such as the internet via a secure connection. The user then selects one of two user interfaces to input the patient's dental condition. The preferred method for the novice user is the visual-user interface (FIG. 17-22) shown as step 2802. The advanced user will likely prefer the alternative user interface (FIG. 25) illustrated as step 2803).

But does not explicitly state, limitation of claim "image is acquired with a cell phone".

On the other hand "Borovinskih", in the same field of "photograph-based assessment of dental treatments and procedures", teaches (page 4, paragraph, [0036] FIGS. 5A-D graphically illustrate the treatment-monitoring method to which the current document is, in part, directed. As shown in FIG. 5A, at a particular current point in time, t.sub.82, during a dental patient's treatment or procedure, represented in FIG. 5A by vertical arrow 502, a dental practitioner examines the patient and takes a number n of two-dimensional pictures of the patient's teeth 504. Alternatively, in certain implementations, the two-dimensional pictures may be taken by a patient's friend or relative, or even the patient, using a camera timer or smart-phone features that facilitate acquisition of images of a user. In the current example, n is equal to 3. In general, each photograph or subset of the photographs represents a certain, standard view or image type. A dental practitioner or other person is provided with instructions for capturing an image of a

particular standard view or type. As shown in FIG. 5B, once the practitioner has submitted these two-dimensional images, along with patient information, an indication of the time that the two-dimensional images were captured, and other such information, the treatment-monitoring system, to which the current document is, in part, directed, determines camera parameters for virtual cameras 506-508, the orientations and positions of which most likely correspond to the camera parameters of the dental practitioner's camera at the points in time at which each of the corresponding n two-dimensional pictures, 510-512, respectively, were captured by the dental practitioner or other person).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the Kuo invention according to the teaching of Borovinskih because to combine “the central server to be configured to communicate with the terminal and data storage unit to access software stored in the data storage unit that may be performed over the internet that is taught by the Kuo invention according to the teaching taught by Borovinskih, using a smart phone and camera to capture dental images would provide for an improved method and system of acquiring and transmitting dental images, information, and messages captured with a camera in a smart (cell) phone and sent via the internet.

Regarding claim 2, Kuo discloses the method as claimed in claim 1, said method comprising the following steps: A) creation of a learning base comprising more than 1000 images of dental arches, or "historical images", each historical image comprising one or more zones each representing a tooth, or "historical tooth zones", to each of which, for at least one tooth attribute, a tooth attribute value is assigned (see claim 1, also page 16, paragraph, [0202] in this arrangement, the first four positions "A" to "D" of the matrix represent the patient's initial dentition (as previously described), positions "A*" to "D*" of the matrix represent the patient's

target dentition or treatment goal, and positions "A**" to "D**" of the matrix represent the patient's actual final dentition or treatment outcome. Because the number of positions in the matrix may be variable, and since each position can include symbols, alphanumeric characters or other representations, the depth of individual patient cases that is stored is may be detailed and specific to the patient and/or the associated profile or condition. Using the 4 possible treatment outcomes illustrated in FIG. 14 and the 2,701 possible combinations in FIG. 12, this equates to 2,701.times.4=10,804 possible paired combinations between initial and goal.

Also page 9, paragraphs, [0090-0092] in another embodiment, practitioners are clustered into groups by observed clinician treatment preferences, and treatment parameters are adjusted within each group to coincide more closely with observed treatment preferences. Practitioners without observed histories are then assigned to groups based on similarity of known variables to those within clusters with known treatment histories. FIG. 1E shows an exemplary process for clusterizing practices. First, the process clusterizes treatment practice based on clinician treatment history such as treatment preferences, outcomes, and demographic and practice variables (20). Next, the system models preferred clinical constraints within each cluster (22). Next, the system assigns clinicians without treatment history to clusters in 20 based on demographic and practice variables (24). In one embodiment, the system performs process 100 (see FIG. 2A) separately within each cluster, using cluster-specific clinical constraints (26). Additionally, the system updates clusters and cluster assignments as new treatment and outcome data arrives (28). FIG. 1F shows another embodiment of a data mining system to generate proposed treatments. First, the system identifies/clusterizes patient histories having detailed follow-up (such as multiple high-resolution scans), based on detailed follow-up data, diagnosis, treatment parameters and outcomes, and demographic variables (40));

B) Training of at least one deep learning device, preferably a neural network, by means of the learning base (see page 4, paragraphs, [0074-0075] in one embodiment, data driven analyzers may be applied. These data driven analyzers may incorporate a number of models such as parametric statistical models, non-parametric statistical models, clustering models, nearest neighbor models, regression methods, and engineered (artificial) neural networks. Prior to operation, data driven analyzers or models are built using one or more training sessions. The data used to build the analyzer or model in these sessions are typically referred to as training data. As data driven analyzers are developed by examining only training examples, the selection of the training data can significantly affect the accuracy and the learning speed of the data driven analyzer. One approach used heretofore generates a separate data set referred to as a test set for training purposes. The test set is used to avoid overfitting the model or analyzer to the training data. Overfitting refers to the situation where the analyzer has memorized the training data so well that it fails to fit or categorize unseen data. Typically, during the construction of the analyzer or model, the analyzer's performance is tested against the test set. The selection of the analyzer or model parameters is performed iteratively until the performance of the analyzer in classifying the test set reaches an optimal point. At this point, the training process is completed. An alternative to using an independent training and test set is to use a methodology called cross-validation. Cross-validation can be used to determine parameter values for a parametric analyzer or model for a non-parametric analyzer. In cross-validation, a single training data set is selected. Next, a number of different analyzers or models are built by presenting different parts of the training data as test sets to the analyzers in an iterative process. The parameter or model structure is then determined on the basis of the combined performance of all models or analyzers. Under

the cross-validation approach, the analyzer or model is typically retrained with data using the determined optimal model structure);

C) submission of the analysis image to said at least one deep learning device for it to determine at least one probability relating to an attribute value of at least one tooth represented on a zone representing, at least partially, said tooth in the analysis image, or "analysis tooth zone" (see page 5, paragraphs, [0080-0082] in one embodiment, transitions are restricted to reentry of a state or entry to one of the next two states. Such transitions are defined in the model as transition probabilities. For example, a treatment pattern currently having a frame of feature signals in state 2 has a probability of reentering state 2 of a(2,2), a probability a(2,3) of entering state 3 and a probability of a(2,4)=1-a(2,2)-a(2,3) of entering state 4. The probability a(2,1) of entering state 1 or the probability a(2,5) of entering state 5 is zero and the sum of the probabilities a(2,1) through a(2,5) is one. Although the preferred embodiment restricts the flow graphs to the present state or to the next two states, one skilled in the art can build an HMM model with more flexible transition restrictions, although the sum of all the probabilities of transitioning from any state must still add up to one. In each state j of the model, the current feature frame may be identified with one of a set of predefined output symbols or may be labeled probabilistically. In this case, the output symbol probability b (j) (O (t)) corresponds to the probability assigned by the model that the feature frame symbol is O (t). The model arrangement is a matrix A= [a (i, j)] of transition probabilities and a technique of computing B= [b (j) (O (t))]. In one embodiment, the Markov model is formed for a reference pattern from a plurality of sequences of training patterns and the output symbol probabilities are multivariate Gaussian function probability densities. The dental treatment information traverses through the feature extractor. During learning, the resulting feature vector series is processed by a parameter

estimator, whose output is provided to the hidden Markov model. The hidden Markov model is used to derive a set of reference pattern templates, each template representative of an identified pattern in a vocabulary set of reference treatment patterns. The Markov model reference templates are next utilized to classify a sequence of observations into one of the reference patterns based on the probability of generating the observations from each Markov model reference pattern template. During recognition, the unknown pattern can then be identified as the reference pattern with the highest probability in the likelihood calculator);

D) determination, as a function of said probability, of the presence of a tooth at a position represented by said analysis tooth zone, and of the attribute value of said tooth (see above, also page 6, paragraph, [0092] FIG. 1F shows another embodiment of a data mining system to generate proposed treatments. First, the system identifies/clusterizes patient histories having detailed follow-up (such as multiple high-resolution scans), based on detailed follow-up data, diagnosis, treatment parameters and outcomes, and demographic variables (40). Within each cluster, the system models discrepancies between intended position and actual positions obtained from follow-up data (42). Further, within each cluster, the system models risk for special undesirable outcomes (44). At a second tier of clustering, patient histories with less detailed follow-up data are clusterized based on available variables. The second-tier clustering is partial enough that each of the larger number of second tier clusters can either be assigned to clusters calculated in 40 or else considered a new cluster (46). The system refines step 42 models with additional records from step 46 clusters (48). It can also refine step 44 models with additional records from step 48 clusters (50). At a third tier of clustering (zone), the system then assigns new patients to step 46 clusters based on diagnosis, demographic, and initial physical (52). Within each step 52 cluster, the system models expected discrepancies between intended position

and actual positions (54). From step 54, the system uses revised expected position information where relevant (including 232 and 250, FIG. 2B) (67). Additionally, within each step 52 cluster, the system models risk for undesirable outcomes (56). From step 56, the system also flags cases that require special attention and clinical constraints (as in 204 and 160, FIGS. 2B and 2A) (69). The process then customizes treatment plan to each step 52 cluster (58). Next, the system iteratively collects data (61) and loops back to identify/clusterize patient histories (40). Additionally, clusters can be revised and reassigned (63). The system also continually identifies clusters without good representation for additional follow-up analysis (65)).

Regarding claim 3, Kuo discloses the method as claimed in claim 1, in which a first deep learning device is implemented to assess a probability relating to the presence, at a location in said analysis image, of an analysis tooth zone (page 5, paragraph, [0075] in one embodiment, the data mining software 3 (FIG. 1A) can be a "spider" or "crawler" to grab data on the database 2 (FIG. 1A) for indexing. In one embodiment, clustering operations are performed to detect patterns in the data. In another embodiment, a neural network is used to recognize each pattern as the neural network is quite robust at recognizing dental treatment patterns. Once the treatment features have been characterized, the neural network then compares the input dental information with stored templates of treatment vocabulary known by the neural network recognizer, among others. The recognition models can include a Hidden Markov Model (HMM), a dynamic programming model, a neural network, a fuzzy logic, or a template matcher, among others. These models may be used singly or in combination. Also page 5, paragraphs, [0079-0080] in the preferred embodiment, the Markov model is used to model probabilities for sequences of treatment observations. The transitions between states are represented by a transition matrix A= [a (i, j)]. Each a (i, j) term of the transition matrix is the probability of making a transition to state

j given that the model is in state i. The output symbol probability of the model is represented by a set of functions B=[b(j), where the b(j) term of the output symbol matrix is the function that when evaluated on a specified value O(t) returns the probability of outputting observation O(t), given that the model is in state j. The first state is always constrained to be the initial state for the first time frame of the Markov chain, only a prescribed set of left to right state transitions are possible. A predetermined final state is defined from which transitions to other states cannot occur. In one embodiment, transitions are restricted to reentry of a state or entry to one of the next two states. Such transitions are defined in the model as transition probabilities. For example, a treatment pattern currently having a frame of feature signals in state 2 has a probability of reentering state 2 of a(2,2), a probability a(2,3) of entering state 3 and a probability of a(2,4)=1-a(2,2)-a(2,3) of entering state 4. The probability a(2,1) of entering state 1 or the probability a(2,5) of entering state 5 is zero and the sum of the probabilities a(2,1) through a(2,5) is one. Although the preferred embodiment restricts the flow graphs to the present state or to the next two states, one skilled in the art can build an HMM model with more flexible transition restrictions, although the sum of all the probabilities of transitioning from any state must still add up to one).

Regarding claim 4, Kuo discloses the method as claimed in claim 1, in which a second deep learning device is implemented to assess a probability relating to the type of tooth represented in an analysis tooth zone (page 5, paragraph, [0075] in one embodiment, the data mining software 3 (FIG. 1A) can be a "spider" or "crawler" to grab data on the database 2 (FIG. 1A) for indexing. In one embodiment, clustering operations are performed to detect patterns in the data. In another embodiment, a neural network is used to recognize each pattern as the neural network is quite robust at recognizing dental treatment patterns. Once the treatment features have

been characterized, the neural network then compares the input dental information with stored templates of treatment vocabulary known by the neural network recognizer, among others. The recognition models can include a Hidden Markov Model (HMM), a dynamic programming model, a neural network, a fuzzy logic, or a template matcher, among others. These models may be used singly or in combination. Also page 5, paragraph, [0083] the HMM template has a number of states, each having a discrete value. However, as treatment pattern features may have a dynamic pattern in contrast to a single value, the addition of a neural network at the front end of the HMM in an embodiment provides the capability of representing states with dynamic values. The input layer of the neural network comprises input neurons. The outputs of the input layer are distributed to all neurons in the middle layer. Similarly, the outputs of the middle layer are distributed to all output neurons, which output neurons correspond one-to one with internal states of the HMM. However, each output has transition probabilities to itself or to other outputs, thus forming a modified HMM. Each state of the thus formed HMM is capable of responding to a particular dynamic signal, resulting in a more robust HMM. Alternatively, the neural network can be used alone without resorting to the transition probabilities of the HMM architecture).

Regarding claim 5, Kuo discloses the method as claimed in claim 1, in which said tooth attribute is chosen from a tooth number, a tooth type, a tooth shape parameter, a tooth appearance parameter, a parameter relating to the state of the tooth, an age for the patient, or a combination of these attributes (see page 12, paragraph, [0157] For example, consider the following patient identifier 1:NNABN. The identifier 1:NNABN would represent: <u>tooth number</u> 1 of a 32-bit address which has a natural mesial surface (sub address position 1), an occlusal amalgam (sub address position 2), a natural distal surface (sub address position 3), a buccal/facial composite (sub address position 4), and a natural lingual surface (sub address

position 5). Also page 13, paragraph, [0167] treatment Goal 4: Optimal set-up--the objective of this goal is to make the entire bite close to "textbook" ideal, including both the "canine and molar function". Also page 19-20, paragraphs [0246] and [0267], more specifically, referring back to step 2930 at (3A), in one embodiment, one or more predefined treatment goals may be provided to the user (doctor, clinician or the patient) based on the patient's initial dental parameters. In such embodiment, the predefined treatment goals may include common treatment goals associated with the patient's initial dental parameters. For example, some predefined treatment goals are "pre-restorative setup", which involves aligning the teeth in anticipation of future dental work on the teeth following one or more orthodontic treatments; "esthetic alignment", which involves aligning the teeth for cosmetic improvement without altering the posterior bite relationship; "anterior function improvement", which involves aligning the teeth for improvement of the function and guiding relationship from the anterior teeth; and "optimal set-up", which involves aligning the teeth to provide as optimal of a bite relationship as possible given the patient's current initial dental characteristics).

Regarding claim 6, Kuo discloses the method as claimed in claim 4, in which, in the step 1), a learning base is created comprising more than 10 000 historical images (see claim 4, also page 16, paragraph, [0202] in this arrangement, the first four positions "A" to "D" of the matrix represent the patient's initial dentition (as previously described), positions "A*" to "D*" of the matrix represent the patient's target dentition or treatment goal, and positions "A**" to "D**" of the matrix represent the patient's actual final dentition or treatment outcome. Because the number of positions in the matrix may be variable, and since each position can include symbols, alphanumeric characters or other representations, the depth of individual patient cases that is stored is may be detailed and specific to the patient and/or the associated profile or condition.

Using the 4 possible treatment outcomes illustrated in FIG. 14 and the 2,701 possible combinations in FIG. 12, this equates to 2,701.times.4=10,804 possible paired combinations between initial and goal).

Regarding claim 14, Kuo discloses the method as claimed in claim 1, in which the analysis image is in real colors (see page 20, paragraphs, [0249] and [0252], in a further embodiment, a maximum difficulty rating may be pre-designated for a particular user (for example, the doctor or clinician) such that the predefined treatment goals displayed as available to that user may include only those treatment goals up to the maximum pre-designated difficulty rating. In one embodiment, the difficulty ratings may be associated with an alphanumeric scale, a graphical scale (including icons, colors, images and the like), an auditory scale, or one or more combined scale for ease of use. Referring back to step 2930, at (3B) of FIG. 29, in one embodiment, the feedback from the query function provided to the user can also include rating of treatment goals once an initial assessment is created. In such embodiment, an assessment of treatment difficulty is done based on the combination of the patient's initial dental condition and selected goal. For example, a treatment difficulty indicator of 1, 2, or 3 may be attributed to a given initial dental condition/treatment goal combination, whereby "1" is a difficulty indicator of an "easy" combination, "2" is a difficulty indicator of a "moderate" combination, and "3" is a difficulty indicator of a "severe" combination. Difficulty indicators may also be “associated with colors”, symbols, and alphanumeric characters.

Regarding claim 15, Kuo discloses a method for analyzing an image, called "analysis image", of a dental arch of a patient, method in which the analysis image is submitted to a neural network, in order to determine at least one value of an image attribute relating to the analysis image, the analysis image being a photograph or an image taken from a film, in which said

image attribute relates to a position or an orientation or a calibration of an acquisition apparatus used to acquire said analysis image or a combination thereof, or a quality of the analysis image, and in particular relating to the brightness, to the contrast or to the sharpness of the analysis image, or a combination thereof (see claim 1, also page 5, paragraph, [0083] the HMM template has a number of states, each having a discrete value. However, as treatment pattern features may have a dynamic pattern in contrast to a single value, the addition of a neural network at the front end of the HMM in an embodiment provides the capability of representing states with dynamic values. The input layer of the neural network comprises input neurons. The outputs of the input layer are distributed to all neurons in the middle layer. Similarly, the outputs of the middle layer are distributed to all output neurons, which output neurons correspond one-to one with internal states of the HMM. However, each output has transition probabilities to itself or to other outputs, thus forming a modified HMM. Each state of the thus formed HMM is capable of responding to a particular dynamic signal, resulting in a more robust HMM. Alternatively, the neural network can be used alone without resorting to the transition probabilities of the HMM architecture. Also page 7, paragraph, [0102] as an initial step, a mold or a scan of patient's teeth or mouth tissue is acquired (110). This step generally involves taking casts of the patient's teeth and gums, and may in addition or alternately involve taking wax bites, direct contact scanning, x-ray imaging, tomographic imaging, sonographic imaging, and other techniques for obtaining information about the position and structure of the teeth, jaws, gums and other orthodontically relevant tissue. From the data so obtained, a digital data set is derived that represents the initial (that is, pretreatment) arrangement of the patient's teeth and other tissues).

Regarding claim 19, Kuo discloses the method as claimed in claim 17, in which the analysis image is in real colors (see claim 1, also page 20, paragraphs, [0249] and [0252], in a

further embodiment, a maximum difficulty rating may be pre-designated for a particular user (for example, the doctor or clinician) such that the predefined treatment goals displayed as available to that user may include only those treatment goals up to the maximum pre-designated difficulty rating. In one embodiment, the difficulty ratings may be associated with an alphanumeric scale, a graphical scale (including icons, colors, images and the like), an auditory scale, or one or more combined scale for ease of use. Referring back to step 2930, at (3B) of FIG. 29, in one embodiment, the feedback from the query function provided to the user can also include rating of treatment goals once an initial assessment is created. In such embodiment, an assessment of treatment difficulty is done based on the combination of the patient's initial dental condition and selected goal. For example, a treatment difficulty indicator of 1, 2, or 3 may be attributed to a given initial dental condition/treatment goal combination, whereby "1" is a difficulty indicator of an "easy" combination, "2" is a difficulty indicator of a "moderate" combination, and "3" is a difficulty indicator of a "severe" combination. Difficulty indicators may also be “associated with colors”, symbols, and alphanumeric characters.

Regarding claim 21, Kuo discloses the method as claimed in claim 1, in which a front image, a right image and a left image are acquired (see claim 1, also page 14, paragraphs, [0177-0179] referring to FIG. 17, an exemplary selection process display 1700 is shown for the sagittal dimension (matrix address position "A" in FIG. 12)--right buccal, right canine/cuspid component. A series of images of reference dentition conditions 1701-1703 are displayed in conjunction with buttons 1704 allowing the images to be scrolled to the left or right. A user clicks the left or right arrow buttons 1704 to select the image of the reference dentition condition that best reflects the patient's current condition specifically at the location(s) indicated by the focusing arrows indicated in 1702. In this exemplary embodiment, a user clicks the left or right

arrow buttons to select the cuspid (canine) relationship that is similar to a patient's current occlusion. Once the selection is made, the next button 1705 is pressed to move onto the next screen. The exemplary selection process display 1700 also includes buttons 1706-1709 to allow a user to go back, access a glossary, ask for advice, and save the information, respectively. Referring to FIG. 18, an exemplary selection process display 1800 is shown for the sagittal category--left buccal, left cuspid component. A series of images of reference dentition conditions 1801-1803 are displayed in association with buttons 804 allowing the images to be scrolled to the left or right. A user clicks the left or right arrow buttons 804 to select the image of the reference dentition condition that best reflects the patient's current condition. In this exemplary embodiment, a user clicks the left or right arrow buttons to select the cuspid relationship that is similar to a patient's current occlusion).

With regard to claims 10, 17-18 and 20 the arguments analogous to those presented above for claims 1, 2, 3, 4, 5, 6, 14, 15, 19 and 21 are respectively applicable to claims 10, 17-18 and 20.

Allowable Subject Matter

6. Claims 7 and 8 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Contact Information

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Seyed Azarian whose telephone number is (571) 272-7443. The examiner can normally be reached on Monday through Thursday from 6:00 a.m. to 7:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Bella, can be reached at (571) 272-7778. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application information Retrieval (PAIR) system. Status information for published application may be obtained from either Private PAIR or Public PAIR.

Status information about the PAIR system, see http:// pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/SEYED H AZARIAN/
Primary Examiner, Art Unit 2667
December 25, 2020

EXHIBIT OP-2

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/031,125	07/10/2018	Philippe SALAH	N&P-51423	3171

108676 7590 06/02/2020
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EXAMINER	
AZARIAN, SEYED H	

ART UNIT	PAPER NUMBER
2667	

NOTIFICATION DATE	DELIVERY MODE
06/02/2020	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patdoc@cooperlegalgroup.com

Office Action Summary	Application No. 16/031,125	Applicant(s) SALAH et al.	
	Examiner SEYED H AZARIAN	Art Unit 2667	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
  Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 5/8/2020.
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☑ This action is **FINAL.** 2b) ☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-16 is/are pending in the application.
5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-6 and 9-16 is/are rejected.

8) ☑ Claim(s) 7-8 is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 7/10/2018 is/are: a)☑ accepted or b)☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
Certified copies:
a)☑ All b)☐ Some** c)☐ None of the:
1.☑ Certified copies of the priority documents have been received.
2.☐ Certified copies of the priority documents have been received in Application No. _____.
3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b)
Paper No(s)/Mail Date _______.

3) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _______.

4) ☐ Other: _______.

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

RESPONSE TO AMENDMENT

1. Based on applicant's amendment filed on 5/8/2020, see page 2 through 13, of the remark, with respect to amended claims 1, 2, 9, 10, 11 and new claims 12-16, have been fully considered and are moot in view of the new ground (s) of rejection as necessitated by applicant's amendment is made in view of Kopelman et al (Pub. No: U.S. 2018/0168780 A1) and further Borovinskih et al (Pub. No: U.S. 2017/0049311 A1).

2. Also upon further consideration, based on applicant's remark, the 35 U.S.C. 112 (b) and 35 U.S.C. 112 (a) rejections, are hereby withdrawn.

3. Examiner Note:

Examiner respectfully want to point out, regarding limitations of amended claim 1 "at least one value chosen in a group consisting of a value". Is rejected under "803.02 **Markush Claims** [R-08.2012]". A Markush-type claim recites alternatives in a format such as "selected from group consisting of A, B and C." See *Ex parte Markush,* 1925 C.D. 126 (Comm'r Pat. 1925). However, any of two limitations will satisfy the claim rejection.

Contrary to the applicant's assertion, as he traverses, regarding limitations of amended claim 1, that Kuo does not teach or suggest "the submission of an image to a neural network, or determining values of a tooth attribute or an image attribute".

Contrary to the applicant's assertion, Examiner indicates, that Kuo clearly discloses:

(I): (see pages 3-5, paragraphs, [0060-0068] FIG. 1A shows one exemplary dental data

mining system. In this system, dental treatment and outcome data sets 1 are stored in a database or information warehouse 2. The data is extracted by data mining software 3 that generates results 4. The data mining software can interrogate the information captured and/or updated in the database 2 and can generate an output data stream correlating a patient tooth problem with a dental appliance solution. Note that the output of the data mining software can be most advantageously, self-reflexively, fed as a subsequent input to at least the database and the data mining correlation algorithm. The result of the data mining system of FIG. 1A is used for defining appliance configurations or changes to appliance configurations for incrementally moving teeth. The tooth movements will be those normally associated with orthodontic treatment, including translation in all three orthogonal directions, rotation of the tooth centerline in the two orthogonal directions with rotational axes perpendicular to a vertical centerline ("root angulation" and "torque"), as well as rotation of the tooth centerline in the orthodontic direction with an axis parallel to the vertical centerline ("pure rotation"). In one embodiment, the data mining system captures the 3-D treatment planned movement, the start position and the final achieved dental position. The system compares the outcome to the plan, and the outcome can be achieved using any treatment methodology including removable appliances as well as fixed appliances such as orthodontic brackets and wires, or even other dental treatment such as comparing achieved to plan for orthognathic surgery, periodontics, restorative, among others. In one embodiment, a teeth superimposition tool is used to match treatment files of each arch scan. The refinement scan is superimposed over the initial one to arrive at a match based upon tooth anatomy and tooth coordinate system. After teeth in the two arches are matched, the superimposition tool asks for a reference in order to relate the upper arch to the lower arch. When the option "statistical filtering" is selected, the superimposition tool measures the amount

of movement for each tooth by first eliminating as reference the ones that move (determined by the difference in position between the current stage and the previous one) more than one standard deviation either above or below the mean of movement of all teeth. The remaining teeth are then selected as reference to measure movement of each tooth. FIG. 1B shows an analysis of the performance of one or more dental appliances. "Achieved" movement is plotted against "Goal" movement in scatter graphs, and trend lines are generated. Scatter graphs are shown to demonstrate where all "scattered" data points are, and trend lines are generated to show the performance of the dental appliances. In one embodiment, trend lines are selected to be linear (they can be curvilinear); thus trend lines present as the "best fit" straight lines for all "scattered" data. The performance of the Aligners is represented as the slope of a trend line. The Y axis intercept models the incidental movement that occurs when wearing the Aligners. Predictability is measured by R.sup.2 that is obtained from a regression computation of "Achieved" and "Goal" data.

(II): Also page 3, paragraphs, [0068-0069], in one embodiment, clinical parameters in steps such as 170 (FIG. 2A) and 232 (FIG. 2B) are made more precise by allowing for the statistical deviation of targeted from actual tooth position. For example, a subsequent movement target might be reduced because of a large calculated probability of currently targeted tooth movement not having been achieved adequately, with the result that there is a high probability the subsequent movement stage will need to complete work intended for an earlier stage. Similarly, targeted movement might overshoot desired positions especially in earlier stages so that expected actual movement is better controlled. This embodiment sacrifices the goal of minimizing round trip time in favor of achieving a higher probability of targeted end-stage outcome. This methodology is accomplished within treatment plans specific to clusters of similar

patient cases. Table 1 shows grouping of teeth in one embodiment. The sign convention of tooth movements is indicated in Table 2. Different tooth movements of the selected 60 arches were demonstrated in Table 3 with performance sorted by descending order. The appliance performance can be broken into 4 separate groups: high (79-85%), average (60-68%), below average (52-55%), and inadequate (24-47%). Table 4 shows ranking of movement predictability. Predictability is broken into 3 groups: highly predictable (0.76-0.82), predictable (0.43-0.63) and unpredictable (0.10-0.30). For the particular set of data, for example, the findings are as follows: Incisor intrusion, and anterior intrusion performance are high. The range for incisor intrusion is about 1.7 mm, and for anterior intrusion is about 1.7 mm. These movements are highly predictable.

(III): pages 4-5, paragraphs, [0074-0075] in one embodiment, data driven analyzers may be applied. These data driven analyzers may incorporate a number of models such as parametric statistical models, non-parametric statistical models, clustering models, nearest neighbor models, regression methods, and engineered (artificial) neural networks. Prior to operation, data driven analyzers or models are built using one or more training sessions. The data used to build the analyzer or model in these sessions are typically referred to as training data. As data driven analyzers are developed by examining only training examples, the selection of the training data can significantly affect the accuracy and the learning speed of the data driven analyzer. One approach used heretofore generates a separate data set referred to as a test set for training purposes. The test set is used to avoid overfitting the model or analyzer to the training data. Overfitting refers to the situation where the analyzer has memorized the training data so well that it fails to fit or categorize unseen data. Typically, during the construction of the analyzer or model, the analyzer's performance is tested against the test set. The selection of the analyzer or

model parameters is performed iteratively until the performance of the analyzer in classifying the test set reaches an optimal point. At this point, the training process is completed. An alternative to using an independent training and test set is to use a methodology called cross-validation. Cross-validation can be used to determine parameter values for a parametric analyzer or model for a non-parametric analyzer. In cross-validation, a single training data set is selected. Next, a number of different analyzers or models are built by presenting different parts of the training data as test sets to the analyzers in an iterative process. The parameter or model structure is then determined on the basis of the combined performance of all models or analyzers. Under the cross-validation approach, the analyzer or model is typically retrained with data using the determined optimal model structure. In one embodiment, the data mining software 3 (FIG. 1A) can be a "spider" or "crawler" to grab data on the database 2 (FIG. 1A) for indexing. In one embodiment, clustering operations are performed to detect patterns in the data. In another embodiment, a neural network is used to recognize each pattern as the neural network is quite robust at recognizing dental treatment patterns. Once the treatment features have been characterized, the neural network then compares the input dental information with stored templates of treatment vocabulary known by the neural network recognizer, among others. The recognition models can include a Hidden Markov Model (HMM), a dynamic programming model, a neural network, a fuzzy logic, or a template matcher, among others. These models may be used singly or in combination.

Finally, page 5, paragraphs, [0083] The HMM template has a number of states, each having a discrete value. However, as treatment pattern features may have a dynamic pattern in contrast to a single value, the addition of a neural network at the front end of the HMM in an embodiment provides the capability of representing states with dynamic values. The input layer

of the neural network comprises input neurons. The outputs of the input layer are distributed to all neurons in the middle layer. Similarly, the outputs of the middle layer are distributed to all output neurons, which output neurons correspond one-to one with internal states of the HMM. However, each output has transition probabilities to itself or to other outputs, thus forming a modified HMM. Each state of the thus formed HMM is capable of responding to a particular dynamic signal, resulting in a more robust HMM. Alternatively, the neural network can be used alone without resorting to the transition probabilities of the HMM architecture).

But does not explicitly state, limitation of amended claim "a value of an image attribute relating to the analysis image".

For this feature Examiner is using the new reference based on the amended claim supplied with this action "Kopelman", in the same field of "dentistry, providing enhancements for dental practitioners", teaches (page 5, paragraph, [0065], analyze patient image data. The analysis may involve direct analysis (e.g., pixel-based and/or other point-based analysis), the application of machine learning, the application of image registration, and/or the application of image recognition. The AOI identifying modules 115 may identify areas of interest directly from the image data 135 received from the image capture device 160 or based on a comparison of the received image data 135 and reference data 138 or previous patient data 140. For example, an AOI identifying module 115 may use one or more algorithms or detection rules to analyze the shape of a tooth, color of a tooth, position of a tooth, or other characteristics of a tooth to determine if there is any AOI that should be highlighted for a dental practitioner.

Also page 8, paragraph, [0088] dental arch/oral cavity identifier 166 may be responsible for identifying an oral cavity in received image data 162 and for identifying a dental arch in the oral cavity. To identify the oral cavity, dental arch/oral cavity identifier 166 performs image

processing on the image data 162 using image recognition techniques. For example, oral cavities have visual cues that can be used to pinpoint the oral cavities in the image data 162. Dental arch/oral cavity identifier 166 may include an oral cavity profile that may have been generated using machine learning techniques such as neural networks. Processing the image data 162 may include first pre-processing the image data such as by performing re-sampling in a new coordinate system, performing noise reduction, enhancing contrast, adjusting scale, etc. Processing the image data 162 may additionally include performing feature extraction to identify lines, edges, ridges, point clouds, corners, point blobs, and so on. Processing the image data 162 may additionally include performing detection and/or segmentation to select those lines, edges, ridges, point clouds, corners, point blobs, etc. that represent the oral cavity and/or objects within the oral cavity.

Finally, page 13, paragraph, [0124] turning to keying which conveys AOI classification, indicators may identify classifications assigned to intraoral areas of interest. For examples, AOIs may be classified as tooth wear, tooth cracks, tooth positions, gum recession, gingivitis, plaque, or other types of AOI. AOIs representing changes in patient dentition may represent tooth decay, receding gums, tooth wear, a broken tooth, gum disease, gum color, moles, lesions, tooth shade, tooth color, an improvement in orthodontic alignment, degradation in orthodontic alignment, and so on. Different criteria may be used for identifying each such class of AOI. For example, a change in orthodontic alignment may be identified based on a planned orthodontic treatment, while tooth wear may be identified by an unnatural shape of a tooth).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the Kuo invention according to the teaching of Kopelman because to combine “dynamic orthodontic assessment and treatment profiles”, that is taught by

the Kuo invention according to the teaching taught by Kopelman, identify features in the image data based on analysis of the image data, using a neural network. Analyses image data, includes an image of the whole arch, mouth and teeth identification such as cuspid, incisor and teeth numbers, including values of the attribute such as decayed cracked, indicating unsatisfactory conditions of teeth.

Contrary to the applicant’s assertion, as he traverses, regarding claim 14, that Kuo does not describe “an analysis image being in colors”.

Examiner indicates, that Kuo discloses (see claim 1, also page 20, paragraphs, [0249] and [0252], in a further embodiment, a maximum difficulty rating may be pre-designated for a particular user (for example, the doctor or clinician) such that the predefined treatment goals displayed as available to that user may include only those treatment goals up to the maximum pre-designated difficulty rating. In one embodiment, the difficulty ratings may be associated with an alphanumeric scale, a graphical scale (including icons, colors, images and the like), an auditory scale, or one or more combined scale for ease of use. Referring back to step 2930, at (3B) of FIG. 29, in one embodiment, the feedback from the query function provided to the user can also include rating of treatment goals once an initial assessment is created. In such embodiment, an assessment of treatment difficulty is done based on the combination of the patient's initial dental condition and selected goal. For example, a treatment difficulty indicator of 1, 2, or 3 may be attributed to a given initial dental condition/treatment goal combination, whereby "1" is a difficulty indicator of an "easy" combination, "2" is a difficulty indicator of a "moderate" combination, and "3" is a difficulty indicator of a "severe" combination. Difficulty indicators may also be “associated with colors”, symbols, and alphanumeric characters.

DETAILED ACTION

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1-6 and 9-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over as being anticipated by Kuo (U.S. Pub No: 2015/0132708 A1) in view of Kopelman et al (Pub. No: U.S. 2018/0168780 A1).

Regarding claim 1, Kuo discloses a method for analyzing an image, called "analysis image", of a dental arch of a patient (see the abstract, also pages 3-5, paragraphs, [0060-0068] FIG. 1A shows one exemplary dental data mining system. In this system, dental treatment and outcome data sets 1 are stored in a database or information warehouse 2. The data is extracted by data mining software 3 that generates results 4. The data mining software can interrogate the information captured and/or updated in the database 2 and can generate an output data stream correlating a patient tooth problem with a dental appliance solution. Note that the output of the data mining software can be most advantageously, self-reflexively, fed as a subsequent input to at least the database and the data mining correlation algorithm. The result of the data mining system of FIG. 1A is used for defining appliance configurations or changes to appliance configurations for incrementally moving teeth. The tooth movements will be those normally associated with orthodontic treatment, including translation in all three orthogonal directions, rotation of the tooth centerline in the two orthogonal directions with rotational axes

perpendicular to a vertical centerline ("root angulation" and "torque"), as well as rotation of the tooth centerline in the orthodontic direction with an axis parallel to the vertical centerline ("pure rotation"). In one embodiment, the data mining system captures the 3-D treatment planned movement, the start position and the final achieved dental position. The system compares the outcome to the plan, and the outcome can be achieved using any treatment methodology including removable appliances as well as fixed appliances such as orthodontic brackets and wires, or even other dental treatment such as comparing achieved to plan for orthognathic surgery, periodontics, restorative, among others. In one embodiment, a teeth superimposition tool is used to match treatment files of each arch scan. The refinement scan is superimposed over the initial one to arrive at a match based upon tooth anatomy and tooth coordinate system. After teeth in the two arches are matched, the superimposition tool asks for a reference in order to relate the upper arch to the lower arch. When the option "statistical filtering" is selected, the superimposition tool measures the amount of movement for each tooth by first eliminating as reference the ones that move (determined by the difference in position between the current stage and the previous one) more than one standard deviation either above or below the mean of movement of all teeth. The remaining teeth are then selected as reference to measure movement of each tooth. FIG. 1B shows an analysis of the performance of one or more dental appliances. "Achieved" movement is plotted against "Goal" movement in scatter graphs, and trend lines are generated. Scatter graphs are shown to demonstrate where all "scattered" data points are, and trend lines are generated to show the performance of the dental appliances. In one embodiment, trend lines are selected to be linear (they can be curvilinear); thus trend lines present as the "best fit" straight lines for all "scattered" data. The performance of the Aligners is represented as the slope of a trend line. The Y axis intercept models the incidental movement that occurs when

wearing the Aligners. Predictability is measured by R.sup.2 that is obtained from a regression computation of "Achieved" and "Goal" data.

(II): Also page 3, paragraphs, [0068-0069], in one embodiment, clinical parameters in steps such as 170 (FIG. 2A) and 232 (FIG. 2B) are made more precise by allowing for the statistical deviation of targeted from actual tooth position. For example, a subsequent movement target might be reduced because of a large calculated probability of currently targeted tooth movement not having been achieved adequately, with the result that there is a high probability the subsequent movement stage will need to complete work intended for an earlier stage. Similarly, targeted movement might overshoot desired positions especially in earlier stages so that expected actual movement is better controlled. This embodiment sacrifices the goal of minimizing round trip time in favor of achieving a higher probability of targeted end-stage outcome. This methodology is accomplished within treatment plans specific to clusters of similar patient cases. Table 1 shows grouping of teeth in one embodiment. The sign convention of tooth movements is indicated in Table 2. Different tooth movements of the selected 60 arches were demonstrated in Table 3 with performance sorted by descending order. The appliance performance can be broken into 4 separate groups: high (79-85%), average (60-68%), below average (52-55%), and inadequate (24-47%). Table 4 shows ranking of movement predictability. Predictability is broken into 3 groups: highly predictable (0.76-0.82), predictable (0.43-0.63) and unpredictable (0.10-0.30). For the particular set of data, for example, the findings are as follows: Incisor intrusion, and anterior intrusion performance are high. The range for incisor intrusion is about 1.7 mm, and for anterior intrusion is about 1.7 mm. These movements are highly predictable);

method in which the analysis image is submitted to a neural network, in order to

determine at least one value chosen in a group consisting of a value of a tooth attribute relating to a tooth represented on the analysis image, a value of an image attribute relating to the analysis image, and a combination thereof, the analysis image being a photograph or an image taken from a film (see above, also page 4, paragraphs, [0074-0075] in one embodiment, data driven analyzers may be applied. These data driven analyzers may incorporate a number of models such as parametric statistical models, non-parametric statistical models, clustering models, nearest neighbor models, regression methods, and engineered (artificial) neural networks. Prior to operation, data driven analyzers or models are built using one or more training sessions. The data used to build the analyzer or model in these sessions are typically referred to as training data. As data driven analyzers are developed by examining only training examples, the selection of the training data can significantly affect the accuracy and the learning speed of the data driven analyzer. One approach used heretofore generates a separate data set referred to as a test set for training purposes. The test set is used to avoid overfitting the model or analyzer to the training data. Overfitting refers to the situation where the analyzer has memorized the training data so well that it fails to fit or categorize unseen data. Typically, during the construction of the analyzer or model, the analyzer's performance is tested against the test set. The selection of the analyzer or model parameters is performed iteratively until the performance of the analyzer in classifying the test set reaches an optimal point. At this point, the training process is completed. An alternative to using an independent training and test set is to use a methodology called cross-validation. Cross-validation can be used to determine parameter values for a parametric analyzer or model for a non-parametric analyzer. In cross-validation, a single training data set is selected. Next, a number of different analyzers or models are built by presenting different parts of the training data as test sets to the analyzers in an iterative process. The parameter or model structure

is then determined on the basis of the combined performance of all models or analyzers. Under the cross-validation approach, the analyzer or model is typically retrained with data using the determined optimal model structure.

Also page 5, paragraph [0075], in one embodiment, the data mining software 3 (FIG. 1A) can be a "spider" or "crawler" to grab data on the database 2 (FIG. 1A) for indexing. In one embodiment, clustering operations are performed to detect patterns in the data. In another embodiment, a neural network is used to recognize each pattern as the neural network is quite robust at recognizing dental treatment patterns. Once the treatment features have been characterized, the neural network then compares the input dental information with stored templates of treatment vocabulary known by the neural network recognizer, among others. The recognition models can include a Hidden Markov Model (HMM), a dynamic programming model, a neural network, a fuzzy logic, or a template matcher, among others. These models may be used singly or in combination.

Also page 7, paragraph, [0102] as an initial step, a mold or a scan of patient's teeth or mouth tissue is acquired (110). This step generally involves taking casts of the patient's teeth and gums, and may in addition or alternately involve taking wax bites, direct contact scanning, x-ray imaging, tomographic imaging, sonographic imaging, and other techniques for obtaining information about the position and structure of the teeth, jaws, gums and other orthodontically relevant tissue. From the data so obtained, a digital data set is derived that represents the initial (that is, pretreatment) arrangement of the patient's teeth and other tissues).

Finally, page 5, paragraphs, [0083] The HMM template has a number of states, each having a discrete value. However, as treatment pattern features may have a dynamic pattern in contrast to a single value, the addition of a neural network at the front end of the HMM in an

embodiment provides the capability of representing states with dynamic values. The input layer of the neural network comprises input neurons. The outputs of the input layer are distributed to all neurons in the middle layer. Similarly, the outputs of the middle layer are distributed to all output neurons, which output neurons correspond one-to one with internal states of the HMM. However, each output has transition probabilities to itself or to other outputs, thus forming a modified HMM. Each state of the thus formed HMM is capable of responding to a particular dynamic signal, resulting in a more robust HMM. Alternatively, the neural network can be used alone without resorting to the transition probabilities of the HMM architecture).

But does not explicitly state, limitation of amended claim "a value of an image attribute relating to the analysis image".

For this feature Examiner is using the new reference based on the amended claim supplied with this action "Kopelman", in the same field of "dentistry, providing enhancements for dental practitioners", teaches (page 5, paragraph, [0065], analyze patient image data. The analysis may involve direct analysis (e.g., pixel-based and/or other point-based analysis), the application of machine learning, the application of image registration, and/or the application of image recognition. The AOI identifying modules 115 may identify areas of interest directly from the image data 135 received from the image capture device 160 or based on a comparison of the received image data 135 and reference data 138 or previous patient data 140. For example, an AOI identifying module 115 may use one or more algorithms or detection rules to analyze the shape of a tooth, color of a tooth, position of a tooth, or other characteristics of a tooth to determine if there is any AOI that should be highlighted for a dental practitioner.

Also page 8, paragraph, [0088] dental arch/oral cavity identifier 166 may be responsible for identifying an oral cavity in received image data 162 and for identifying a dental arch in the

oral cavity. To identify the oral cavity, dental arch/oral cavity identifier 166 performs image processing on the image data 162 using image recognition techniques. For example, oral cavities have visual cues that can be used to pinpoint the oral cavities in the image data 162. Dental arch/oral cavity identifier 166 may include an oral cavity profile that may have been generated using machine learning techniques such as neural networks. Processing the image data 162 may include first pre-processing the image data such as by performing re-sampling in a new coordinate system, performing noise reduction, enhancing contrast, adjusting scale, etc. Processing the image data 162 may additionally include performing feature extraction to identify lines, edges, ridges, point clouds, corners, point blobs, and so on. Processing the image data 162 may additionally include performing detection and/or segmentation to select those lines, edges, ridges, point clouds, corners, point blobs, etc. that represent the oral cavity and/or objects within the oral cavity.

Finally, page 13, paragraph, [0124] turning to keying which conveys AOI classification, indicators may identify classifications assigned to intraoral areas of interest. For examples, AOIs may be classified as tooth wear, tooth cracks, tooth positions, gum recession, gingivitis, plaque, or other types of AOI. AOIs representing changes in patient dentition may represent tooth decay, receding gums, tooth wear, a broken tooth, gum disease, gum color, moles, lesions, tooth shade, tooth color, an improvement in orthodontic alignment, degradation in orthodontic alignment, and so on. Different criteria may be used for identifying each such class of AOI. For example, a change in orthodontic alignment may be identified based on a planned orthodontic treatment, while tooth wear may be identified by an unnatural shape of a tooth).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the Kuo invention according to the teaching of Kopelman

because to combine “dynamic orthodontic assessment and treatment profiles”, that is taught by the Kuo invention according to the teaching taught by Kopelman, identify features in the image data based on analysis of the image data, using a neural network. Analyses image data, includes an image of the whole arch, mouth and teeth identification such as cuspid, incisor and teeth numbers, including values of the attribute such as decayed cracked, indicating unsatisfactory conditions of teeth.

Regarding claim 2, Kuo discloses the method as claimed in claim 1, said method comprising the following steps: A) creation of a learning base comprising more than 1000 images of dental arches, or "historical images", each historical image comprising one or more zones each representing a tooth, or "historical tooth zones", to each of which, for at least one tooth attribute, a tooth attribute value is assigned (see claim 1, also page 16, paragraph, [0202] in this arrangement, the first four positions "A" to "D" of the matrix represent the patient's initial dentition (as previously described), positions "A*" to "D*" of the matrix represent the patient's target dentition or treatment goal, and positions "A**" to "D**" of the matrix represent the patient's actual final dentition or treatment outcome. Because the number of positions in the matrix may be variable, and since each position can include symbols, alphanumeric characters or other representations, the depth of individual patient cases that is stored is may be detailed and specific to the patient and/or the associated profile or condition. Using the 4 possible treatment outcomes illustrated in FIG. 14 and the 2,701 possible combinations in FIG. 12, this equates to 2,701.times.4=10,804 possible paired combinations between initial and goal.

Also page 9, paragraphs, [0090-0092] in another embodiment, practitioners are clustered into groups by observed clinician treatment preferences, and treatment parameters are adjusted within each group to coincide more closely with observed treatment preferences. Practitioners

without observed histories are then assigned to groups based on similarity of known variables to those within clusters with known treatment histories. FIG. 1E shows an exemplary process for clusterizing practices. First, the process clusterizes treatment practice based on clinician treatment history such as treatment preferences, outcomes, and demographic and practice variables (20). Next, the system models preferred clinical constraints within each cluster (22). Next, the system assigns clinicians without treatment history to clusters in 20 based on demographic and practice variables (24). In one embodiment, the system performs process 100 (see FIG. 2A) separately within each cluster, using cluster-specific clinical constraints (26). Additionally, the system updates clusters and cluster assignments as new treatment and outcome data arrives (28). FIG. 1F shows another embodiment of a data mining system to generate proposed treatments. First, the system identifies/clusterizes patient histories having detailed follow-up (such as multiple high-resolution scans), based on detailed follow-up data, diagnosis, treatment parameters and outcomes, and demographic variables (40));

B) training of at least one deep learning device, preferably a neural network, by means of the learning base (see page 4, paragraphs, [0074-0075] in one embodiment, data driven analyzers may be applied. These data driven analyzers may incorporate a number of models such as parametric statistical models, non-parametric statistical models, clustering models, nearest neighbor models, regression methods, and engineered (artificial) neural networks. Prior to operation, data driven analyzers or models are built using one or more training sessions. The data used to build the analyzer or model in these sessions are typically referred to as training data. As data driven analyzers are developed by examining only training examples, the selection of the training data can significantly affect the accuracy and the learning speed of the data driven analyzer. One approach used heretofore generates a separate data set referred to as a test set for

training purposes. The test set is used to avoid overfitting the model or analyzer to the training data. Overfitting refers to the situation where the analyzer has memorized the training data so well that it fails to fit or categorize unseen data. Typically, during the construction of the analyzer or model, the analyzer's performance is tested against the test set. The selection of the analyzer or model parameters is performed iteratively until the performance of the analyzer in classifying the test set reaches an optimal point. At this point, the training process is completed. An alternative to using an independent training and test set is to use a methodology called cross-validation. Cross-validation can be used to determine parameter values for a parametric analyzer or model for a non-parametric analyzer. In cross-validation, a single training data set is selected. Next, a number of different analyzers or models are built by presenting different parts of the training data as test sets to the analyzers in an iterative process. The parameter or model structure is then determined on the basis of the combined performance of all models or analyzers. Under the cross-validation approach, the analyzer or model is typically retrained with data using the determined optimal model structure);

C) submission of the analysis image to said at least one deep learning device for it to determine at least one probability relating to an attribute value of at least one tooth represented on a zone representing, at least partially, said tooth in the analysis image, or "analysis tooth zone" (see page 5, paragraphs, [0080-0082] in one embodiment, transitions are restricted to reentry of a state or entry to one of the next two states. Such transitions are defined in the model as transition probabilities. For example, a treatment pattern currently having a frame of feature signals in state 2 has a probability of reentering state 2 of a(2,2), a probability a(2,3) of entering state 3 and a probability of a(2,4)=1-a(2,2)-a(2,3) of entering state 4. The probability a(2,1) of entering state 1 or the probability a(2,5) of entering state 5 is zero and the sum of the

probabilities a(2,1) through a(2,5) is one. Although the preferred embodiment restricts the flow graphs to the present state or to the next two states, one skilled in the art can build an HMM model with more flexible transition restrictions, although the sum of all the probabilities of transitioning from any state must still add up to one. In each state j of the model, the current feature frame may be identified with one of a set of predefined output symbols or may be labeled probabilistically. In this case, the output symbol probability b (j) (O (t)) corresponds to the probability assigned by the model that the feature frame symbol is O (t). The model arrangement is a matrix A= [a (i, j)] of transition probabilities and a technique of computing B= [b (j) (O (t))]. In one embodiment, the Markov model is formed for a reference pattern from a plurality of sequences of training patterns and the output symbol probabilities are multivariate Gaussian function probability densities. The dental treatment information traverses through the feature extractor. During learning, the resulting feature vector series is processed by a parameter estimator, whose output is provided to the hidden Markov model. The hidden Markov model is used to derive a set of reference pattern templates, each template representative of an identified pattern in a vocabulary set of reference treatment patterns. The Markov model reference templates are next utilized to classify a sequence of observations into one of the reference patterns based on the probability of generating the observations from each Markov model reference pattern template. During recognition, the unknown pattern can then be identified as the reference pattern with the highest probability in the likelihood calculator);

D) determination, as a function of said probability, of the presence of a tooth at a position represented by said analysis tooth zone, and of the attribute value of said tooth (see above, also page 6, paragraph, [0092] FIG. 1F shows another embodiment of a data mining system to generate proposed treatments. First, the system identifies/clusterizes patient histories having

detailed follow-up (such as multiple high-resolution scans), based on detailed follow-up data, diagnosis, treatment parameters and outcomes, and demographic variables (40). Within each cluster, the system models discrepancies between intended position and actual positions obtained from follow-up data (42). Further, within each cluster, the system models risk for special undesirable outcomes (44). At a second tier of clustering, patient histories with less detailed follow-up data are clusterized based on available variables. The second-tier clustering is partial enough that each of the larger number of second tier clusters can either be assigned to clusters calculated in 40 or else considered a new cluster (46). The system refines step 42 models with additional records from step 46 clusters (48). It can also refine step 44 models with additional records from step 48 clusters (50). At a third tier of clustering (zone), the system then assigns new patients to step 46 clusters based on diagnosis, demographic, and initial physical (52). Within each step 52 cluster, the system models expected discrepancies between intended position and actual positions (54). From step 54, the system uses revised expected position information where relevant (including 232 and 250, FIG. 2B) (67). Additionally, within each step 52 cluster, the system models risk for undesirable outcomes (56). From step 56, the system also flags cases that require special attention and clinical constraints (as in 204 and 160, FIGS. 2B and 2A) (69). The process then customizes treatment plan to each step 52 cluster (58). Next, the system iteratively collects data (61) and loops back to identify/clusterize patient histories (40). Additionally, clusters can be revised and reassigned (63). The system also continually identifies clusters without good representation for additional follow-up analysis (65)).

Regarding claim 3, Kuo discloses the method as claimed in claim 1, in which a first deep learning device is implemented to assess a probability relating to the presence, at a location in said analysis image, of an analysis tooth zone (page 5, paragraph, [0075] in one embodiment, the

data mining software 3 (FIG. 1A) can be a "spider" or "crawler" to grab data on the database 2 (FIG. 1A) for indexing. In one embodiment, clustering operations are performed to detect patterns in the data. In another embodiment, a neural network is used to recognize each pattern as the neural network is quite robust at recognizing dental treatment patterns. Once the treatment features have been characterized, the neural network then compares the input dental information with stored templates of treatment vocabulary known by the neural network recognizer, among others. The recognition models can include a Hidden Markov Model (HMM), a dynamic programming model, a neural network, a fuzzy logic, or a template matcher, among others. These models may be used singly or in combination. Also page 5, paragraphs, [0079-0080] in the preferred embodiment, the Markov model is used to model probabilities for sequences of treatment observations. The transitions between states are represented by a transition matrix A= [a (i, j)]. Each a (i, j) term of the transition matrix is the probability of making a transition to state j given that the model is in state i. The output symbol probability of the model is represented by a set of functions B=[b(j), where the b(j) term of the output symbol matrix is the function that when evaluated on a specified value O(t) returns the probability of outputting observation O(t), given that the model is in state j. The first state is always constrained to be the initial state for the first time frame of the Markov chain, only a prescribed set of left to right state transitions are possible. A predetermined final state is defined from which transitions to other states cannot occur. In one embodiment, transitions are restricted to reentry of a state or entry to one of the next two states. Such transitions are defined in the model as transition probabilities. For example, a treatment pattern currently having a frame of feature signals in state 2 has a probability of reentering state 2 of a(2,2), a probability a(2,3) of entering state 3 and a probability of a(2,4)=1-a(2,2)-a(2,3) of entering state 4. The probability a(2,1) of entering state 1 or the probability

a(2,5) of entering state 5 is zero and the sum of the probabilities a(2,1) through a(2,5) is one. Although the preferred embodiment restricts the flow graphs to the present state or to the next two states, one skilled in the art can build an HMM model with more flexible transition restrictions, although the sum of all the probabilities of transitioning from any state must still add up to one).

Regarding claim 4, Kuo discloses the method as claimed in claim 1, in which a second deep learning device is implemented to assess a probability relating to the type of tooth represented in an analysis tooth zone (page 5, paragraph, [0075] in one embodiment, the data mining software 3 (FIG. 1A) can be a "spider" or "crawler" to grab data on the database 2 (FIG. 1A) for indexing. In one embodiment, clustering operations are performed to detect patterns in the data. In another embodiment, a neural network is used to recognize each pattern as the neural network is quite robust at recognizing dental treatment patterns. Once the treatment features have been characterized, the neural network then compares the input dental information with stored templates of treatment vocabulary known by the neural network recognizer, among others. The recognition models can include a Hidden Markov Model (HMM), a dynamic programming model, a neural network, a fuzzy logic, or a template matcher, among others. These models may be used singly or in combination. Also page 5, paragraph, [0083] the HMM template has a number of states, each having a discrete value. However, as treatment pattern features may have a dynamic pattern in contrast to a single value, the addition of a neural network at the front end of the HMM in an embodiment provides the capability of representing states with dynamic values. The input layer of the neural network comprises input neurons. The outputs of the input layer are distributed to all neurons in the middle layer. Similarly, the outputs of the middle layer are distributed to all output neurons, which output neurons correspond one-to one with internal

states of the HMM. However, each output has transition probabilities to itself or to other outputs, thus forming a modified HMM. Each state of the thus formed HMM is capable of responding to a particular dynamic signal, resulting in a more robust HMM. Alternatively, the neural network can be used alone without resorting to the transition probabilities of the HMM architecture).

Regarding claim 5, Kuo discloses the method as claimed in claim 1, in which said tooth attribute is chosen from a tooth number, a tooth type, a tooth shape parameter, a tooth appearance parameter, a parameter relating to the state of the tooth, an age for the patient, or a combination of these attributes (see page 12, paragraph, [0157] For example, consider the following patient identifier 1:NNABN. The identifier 1:NNABN would represent: <u>tooth number</u> 1 of a 32-bit address which has a natural mesial surface (sub address position 1), an occlusal amalgam (sub address position 2), a natural distal surface (sub address position 3), a buccal/facial composite (sub address position 4), and a natural lingual surface (sub address position 5). Also page 13, paragraph, [0167] treatment Goal 4: Optimal set-up--the objective of this goal is to make the entire bite close to "textbook" ideal, including both the “canine and molar function”. Also page 19-20, paragraphs [0246] and [0267], more specifically, referring back to step 2930 at (3A), in one embodiment, one or more predefined treatment goals may be provided to the user (doctor, clinician or the patient) based on the patient's initial dental parameters. In such embodiment, the predefined treatment goals may include common treatment goals associated with the patient's initial dental parameters. For example, some predefined treatment goals are "pre-restorative setup", which involves aligning the teeth in anticipation of future dental work on the teeth following one or more orthodontic treatments; "esthetic alignment", which involves aligning the teeth for cosmetic improvement without altering the posterior bite relationship; "anterior function improvement", which involves aligning the teeth for

improvement of the function and guiding relationship from the anterior teeth; and "optimal set-up", which involves aligning the teeth to provide as optimal of a bite relationship as possible given the patient's current initial dental characteristics).

Regarding claim 6, Kuo discloses the method as claimed in claim 4, in which, in the step 1), a learning base is created comprising more than 10 000 historical images (see claim 4, also page 16, paragraph, [0202] in this arrangement, the first four positions "A" to "D" of the matrix represent the patient's initial dentition (as previously described), positions "A*" to "D*" of the matrix represent the patient's target dentition or treatment goal, and positions "A**" to "D**" of the matrix represent the patient's actual final dentition or treatment outcome. Because the number of positions in the matrix may be variable, and since each position can include symbols, alphanumeric characters or other representations, the depth of individual patient cases that is stored is may be detailed and specific to the patient and/or the associated profile or condition. Using the 4 possible treatment outcomes illustrated in FIG. 14 and the 2,701 possible combinations in FIG. 12, this equates to 2,701.times.4=10,804 possible paired combinations between initial and goal).

Regarding claim 11, Kuo discloses the method as claimed in claim 9, in which said image attribute relates to a position and/or an orientation and/or a calibration of an acquisition apparatus used to acquire said analysis image, and/or a quality of the analysis image, and in particular relating to the brightness, to the contrast or to the sharpness of the analysis image, and/or to the content of the analysis image, in particular to the representation of the arches, of the tongue, of the mouth, of the lips, of the jaws, of the gum, of one or more teeth or of an orthodontic appliance (see claim 1, also page 5, paragraph, [0083] the HMM template has a number of states, each having a discrete value. However, as treatment pattern features may have a dynamic pattern

in contrast to a single value, the addition of a neural network at the front end of the HMM in an embodiment provides the capability of representing states with dynamic values. The input layer of the neural network comprises input neurons. The outputs of the input layer are distributed to all neurons in the middle layer. Similarly, the outputs of the middle layer are distributed to all output neurons, which output neurons correspond one-to one with internal states of the HMM. However, each output has transition probabilities to itself or to other outputs, thus forming a modified HMM. Each state of the thus formed HMM is capable of responding to a particular dynamic signal, resulting in a more robust HMM. Alternatively, the neural network can be used alone without resorting to the transition probabilities of the HMM architecture. Also page 7, paragraph, [0102] as an initial step, a mold or a scan of patient's teeth or mouth tissue is acquired (110). This step generally involves taking casts of the patient's teeth and gums, and may in addition or alternately involve taking wax bites, direct contact scanning, x-ray imaging, tomographic imaging, sonographic imaging, and other techniques for obtaining information about the position and structure of the teeth, jaws, gums and other orthodontically relevant tissue. From the data so obtained, a digital data set is derived that represents the initial (that is, pretreatment) arrangement of the patient's teeth and other tissues).

With regard to claims 9 and 10 the arguments analogous to those presented above for claims 1, 2, 3, 4, 5, 6 and 11 are respectively applicable to claims 9 and 10.

Allowable Subject Matter

6. Claims 7 and 8 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

7. Claims 12-16 are rejected under 35 U.S.C. 103(a) as being unpatentable over as being anticipated by Kuo (U.S. Pub No: 2015/0132708 A1) in view of Kopelman et al (Pub. No: U.S. 2018/0168780 A1), further in view of Borovinskih et al (Pub. No: U.S. 2017/0049311 A1).

Regarding claim 12, Kuo discloses the method as claimed in claim 1, comprising an acquisition of the analysis image with an image acquisition apparatus chosen from a cellphone, a connected camera, a smart watch, a tablet or a personal computer, (see page 16, paragraph, [0206] FIG. 28 illustrates a process 2800 for identifying a dentition problem or condition of a patient. The process 2800 is discussed more fully in conjunction with FIGS. 16-27. At step 2801, the user starts by entering identification information such as doctor and patient name, in addition to patient chief concern(s) (FIG. 16). In one embodiment, this comparison may be performed by the central server 1109 (FIG. 11) based on information received, for example, from the terminal 1101, and/or based on stored information retrieved from the data storage unit 1107. This and other related transactions in the process may be performed over a data network such as the internet via a secure connection. The user then selects one of two user interfaces to input the patient's dental condition. The preferred method for the novice user is the visual-user interface (FIG. 17-22) shown as step 2802. The advanced user will likely prefer the alternative user interface (FIG. 25) illustrated as step 2803).

But does not explicitly state, limitation of claim "image is acquired with a cell phone".

On the other hand "Borovinskih", in the same field of "photograph-based assessment of dental treatments and procedures", teaches (page 4, paragraph, [0036] FIGS. 5A-D graphically illustrate the treatment-monitoring method to which the current document is, in part, directed. As shown in FIG. 5A, at a particular current point in time, t.sub.82, during a dental patient's

treatment or procedure, represented in FIG. 5A by vertical arrow 502, a dental practitioner examines the patient and takes a number n of two-dimensional pictures of the patient's teeth 504. Alternatively, in certain implementations, the two-dimensional pictures may be taken by a patient's friend or relative, or even the patient, using a camera timer or smart-phone features that facilitate acquisition of images of a user. In the current example, n is equal to 3. In general, each photograph or subset of the photographs represents a certain, standard view or image type. A dental practitioner or other person is provided with instructions for capturing an image of a particular standard view or type. As shown in FIG. 5B, once the practitioner has submitted these two-dimensional images, along with patient information, an indication of the time that the two-dimensional images were captured, and other such information, the treatment-monitoring system, to which the current document is, in part, directed, determines camera parameters for virtual cameras 506-508, the orientations and positions of which most likely correspond to the camera parameters of the dental practitioner's camera at the points in time at which each of the corresponding n two-dimensional pictures, 510-512, respectively, were captured by the dental practitioner or other person).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the Kuo invention according to the teaching of Borovinskih because to combine “the central server to be configured to communicate with the terminal and data storage unit to access software stored in the data storage unit that may be performed over the internet that is taught by the Kuo invention according to the teaching taught by Borovinskih, using a smart phone and camera to capture dental images would provide for an improved method and system of acquiring and transmitting dental images, information, and messages captured

with a camera in a smart (cell) phone and sent via the internet.

Regarding claim 14, Kuo discloses the method as claimed in claim 1, in which the analysis image is in real colors (see claim 1, also page 20, paragraphs, [0249] and [0252], in a further embodiment, a maximum difficulty rating may be pre-designated for a particular user (for example, the doctor or clinician) such that the predefined treatment goals displayed as available to that user may include only those treatment goals up to the maximum pre-designated difficulty rating. In one embodiment, the difficulty ratings may be associated with an alphanumeric scale, a graphical scale (including icons, colors, images and the like), an auditory scale, or one or more combined scale for ease of use. Referring back to step 2930, at (3B) of FIG. 29, in one embodiment, the feedback from the query function provided to the user can also include rating of treatment goals once an initial assessment is created. In such embodiment, an assessment of treatment difficulty is done based on the combination of the patient's initial dental condition and selected goal. For example, a treatment difficulty indicator of 1, 2, or 3 may be attributed to a given initial dental condition/treatment goal combination, whereby "1" is a difficulty indicator of an "easy" combination, "2" is a difficulty indicator of a "moderate" combination, and "3" is a difficulty indicator of a "severe" combination. Difficulty indicators may also be “associated with colors”, symbols, and alphanumeric characters.

With regard to claims 13 and 15-16 the arguments analogous to those presented above for claims 1, 1 and 14 are respectively applicable to claims 13 and 15-16.

Conclusion

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Contact Information

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Seyed Azarian whose telephone number is (571) 272-7443. The examiner can normally be reached on Monday through Thursday from 6:00 a.m. to 7:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Bella, can be reached at (571) 272-7778. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application information Retrieval (PAIR) system. Status information for published application may be obtained from either Private PAIR or Public PAIR.

Status information about the PAIR system, see http:// pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/SEYED H AZARIAN/
Primary Examiner, Art Unit 2667
May 20,2020

Notice of References Cited	Application/Control No. 16/031,125	Applicant(s)/Patent Under Reexamination SALAH et al.	
	Examiner SEYED H AZARIAN	Art Unit 2667	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20180168780-A1	06-2018	Kopelman; Avi	A61C19/04	1/1
*	B	US-20170049311-A1	02-2017	Borovinskih; Artem	A61C7/002	1/1
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

EXHIBIT OP-3

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/031,201	07/10/2018	Philippe SALAH	N&P-51425	8853

108676 7590 12/20/2019
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EXAMINER	
AZARIAN, SEYED H	

ART UNIT	PAPER NUMBER
2667	

NOTIFICATION DATE	DELIVERY MODE
12/20/2019	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patdoc@cooperlegalgroup.com

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No. 16/031,201	Applicant(s) SALAH et al.	
	Examiner SEYED H AZARIAN	Art Unit 2667	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 7/10/2018.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-13 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-13 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 7/10/2018 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☑ All b)☐ Some** c)☐ None of the:

1.☑ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☑ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Claim Rejections - 35 USC § 112

The following is a quotation of 35 U.S.C. 112(b):
(b) CONCLUSION.- -The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

1. Claims 1, 4, 6 and 10 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

Examiner respectfully wants to point out, there are some minor informalities throughout the claims. For example regarding claim 1, the phrase "<u>preferably</u>", renders the claim(s) indefinite because the claim(s) include(s) elements not actually disclosed (those encompassed by "preferably"), thereby rendering the scope of the claim(s) unascertainable. See MPEP § 2173.05(d). Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112(a):

> (a) IN GENERAL.—The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor or joint inventor of carrying out the invention.

2. Claims 1 and 13 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the "enablement requirement". While the claims recite a series of steps or acts to be performed.

Regarding limitations of claim 1, "image acquired and/or to the position of the acquisition apparatus in relation to said arch and/or to the setting of the acquisition apparatus and/or to the opening of the mouth and/or to the wearing of a dental".

Regarding limitations of claim 13, "image attribute relates to a position and/or an orientation and/or a calibration of an acquisition".

Examiner indicated, as an example regarding claim 13, limitation of "and/or", the specification should disclose three independent embodiments.

[I] One embodiment should disclose "image attribute relates to a position an orientation of an acquisition".

[II], Second embodiment should disclose "image attribute relates to a calibration of an acquisition".

determining of the mineralogical composition metric use an electromagnetic probing tool.

[III], Third embodiment teaches "image attribute relates to a position and calibration of an acquisition".

Stating and/or in the specification is not enough without three independent embodiments as explained above.

DETAILED ACTION

Claim Rejections - 35 USC § 102

3. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a)(1) the claimed invention was patented, described in a printed publication, or in public use, on sale or otherwise available to the public before the effective filing date of the claimed invention.

4. Claims 1-10 are rejected under 35 U.S.C. 102(a) (1) as being anticipated by Kuo (U.S. Pub No: 2015/0132708 A1).

Regarding claim 1, Kuo discloses a method for acquiring an image of a dental arch of a patient, said method comprising the following steps: a') activation of an image acquisition apparatus so as to acquire an image, called "analysis image", of said arch (see page 3, paragraphs, [0063-0064] in one embodiment, a teeth superimposition tool is used to match treatment files of each arch scan. The refinement scan is superimposed over the initial one to arrive at a match based upon tooth anatomy and tooth coordinate system. After teeth in the two arches are matched, the superimposition tool asks for a reference in order to relate the upper arch to the lower arch. When the option "statistical filtering" is selected, the superimposition tool measures the amount of movement for each tooth by first eliminating as reference the ones that move (determined by the difference in position between the current stage and the previous one) more than one standard deviation either above or below the mean of movement of all teeth. The

remaining teeth are then selected as reference to measure movement of each tooth. FIG. 1B shows an analysis of the performance of one or more dental appliances. "Achieved" movement is plotted against "Goal" movement in scatter graphs, and trend lines are generated. Scatter graphs are shown to demonstrate where all "scattered" data points are, and trend lines are generated to show the performance of the dental appliances. In one embodiment, trend lines are selected to be linear (they can be curvilinear); thus trend lines present as the "best fit" straight lines for all "scattered" data. The performance of the Aligners is represented as the slope of a trend line. The Y axis intercept models the incidental movement that occurs when wearing the Aligners. Predictability is measured by R.sup.2 that is obtained from a regression computation of "Achieved" and "Goal" data. Also page 7, paragraph, [0102] as an initial step, a mold or a scan of patient's teeth or mouth tissue is acquired (110). This step generally involves taking casts of the patient's teeth and gums, and may in addition or alternately involve taking wax bites, direct contact scanning, x-ray imaging, tomographic imaging, sonographic imaging, and other techniques for obtaining information about the position and structure of the teeth, jaws, gums and other orthodontically relevant tissue. From the data so obtained, a digital data set is derived that represents the initial (that is, pretreatment) arrangement of the patient's teeth and other tissues);

b') analysis of the analysis image by means of a deep learning device, preferably a neural network, trained by means of a learning base (see page 4, paragraphs, [0074-0075] in one embodiment, data driven analyzers may be applied. These data driven analyzers may incorporate a number of models such as parametric statistical models, non-parametric statistical models, clustering models, nearest neighbor models, regression methods, and engineered (artificial) neural networks. Prior to operation, data driven analyzers or models are built using one or more training sessions. The data used to build the analyzer or model in these sessions are typically

referred to as training data. As data driven analyzers are developed by examining only training examples, the selection of the training data can significantly affect the accuracy and the learning speed of the data driven analyzer. One approach used heretofore generates a separate data set referred to as a test set for training purposes. The test set is used to avoid overfitting the model or analyzer to the training data. Overfitting refers to the situation where the analyzer has memorized the training data so well that it fails to fit or categorize unseen data. Typically, during the construction of the analyzer or model, the analyzer's performance is tested against the test set. The selection of the analyzer or model parameters is performed iteratively until the performance of the analyzer in classifying the test set reaches an optimal point. At this point, the training process is completed. An alternative to using an independent training and test set is to use a methodology called cross-validation. Cross-validation can be used to determine parameter values for a parametric analyzer or model for a non-parametric analyzer. In cross-validation, a single training data set is selected. Next, a number of different analyzers or models are built by presenting different parts of the training data as test sets to the analyzers in an iterative process. The parameter or model structure is then determined on the basis of the combined performance of all models or analyzers. Under the cross-validation approach, the analyzer or model is typically retrained with data using the determined optimal model structure. In one embodiment, the data mining software 3 (FIG. 1A) can be a "spider" or "crawler" to grab data on the database 2 (FIG. 1A) for indexing. In one embodiment, clustering operations are performed to detect patterns in the data. In another embodiment, a neural network is used to recognize each pattern as the neural network is quite robust at recognizing dental treatment patterns. Once the treatment features have been characterized, the neural network then compares the input dental information with stored templates of treatment vocabulary known by the neural network recognizer, among

others. The recognition models can include a Hidden Markov Model (HMM), a dynamic programming model, a neural network, a fuzzy logic, or a template matcher, among others. These models may be used singly or in combination);

c') determination, for the analysis image, as a function of the results of the analysis in the preceding step, of a value for an image attribute (see page 3, paragraphs, [0068-73] in one embodiment, clinical parameters in steps such as 170 (FIG. 2A) and 232 (FIG. 2B) are made more precise by allowing for the statistical deviation of targeted from actual tooth position. For example, a subsequent movement target might be reduced because of a large calculated probability of currently targeted tooth movement not having been achieved adequately, with the result that there is a high probability the subsequent movement stage will need to complete work intended for an earlier stage. Similarly, targeted movement might overshoot desired positions especially in earlier stages so that expected actual movement is better controlled. This embodiment sacrifices the goal of minimizing round trip time in favor of achieving a higher probability of targeted end-stage outcome. This methodology is accomplished within treatment plans specific to clusters of similar patient cases. Table 1 shows grouping of teeth in one embodiment. The sign convention of tooth movements is indicated in Table 2. Different tooth movements of the selected 60 arches were demonstrated in Table 3 with performance sorted by descending order. The appliance performance can be broken into 4 separate groups: high (79-85%), average (60-68%), below average (52-55%), and inadequate (24-47%). Table 4 shows ranking of movement predictability. Predictability is broken into 3 groups: highly predictable (0.76-0.82), predictable (0.43-0.63) and unpredictable (0.10-0.30). For the particular set of data, for example, the findings are as follows: 1. Incisor intrusion, and anterior intrusion performance are high. The range for incisor intrusion is about 1.7 mm, and for anterior intrusion is about 1.7

mm. These movements are highly predictable. Canine intrusion, incisor torque, incisor rotation and anterior torque performance are average. The range for canine intrusion is about 1.3 mm, for incisor torque is about 34 degrees, for incisor rotation is about 69 degrees, and for anterior torque is about 34 degrees. These movements are either predictable or highly predictable. 3. Bicuspid tipping, bicuspid mesialization, molar rotation, and posterior expansion performance are below average. The range for bicuspid mesialization is about 1 millimeter, for bicuspid tipping is about 19 degrees, for molar rotation is about 27 degrees and for posterior expansion is about 2.8 millimeters. Bicuspid tipping and mesialization are unpredictable, whereas the rest are predictable movements. 4. Anterior and incisor extrusion, round teeth and bicuspid rotation, canine tipping, molar distalization, and posterior torque performance are inadequate. The range of anterior extrusion is about 1.7 millimeters, for incisor extrusion is about 1.5 mm, for round teeth rotation is about 67 degrees, for bicuspid rotation is about 63 degrees, for canine tipping is about 26 degrees, for molar distalization is about 2 millimeters, and for posterior torque is about 43 degrees. All are unpredictable movements except bicuspid rotation which is predictable);

d') comparison of said image attribute value with a setpoint (see page 3, paragraphs, [0063-0064] in one embodiment, a teeth superimposition tool is used to match treatment files of each arch scan. The refinement scan is superimposed over the initial one to arrive at a match based upon tooth anatomy and tooth coordinate system. After teeth in the two arches are matched, the superimposition tool asks for a reference in order to relate the upper arch to the lower arch. When the option "statistical filtering" is selected, the superimposition tool measures the amount of movement for each tooth by first eliminating as reference the ones that move (determined by the difference in position between the current stage and the previous one) more than one standard deviation either above or below the mean of movement of all teeth. The

remaining teeth are then selected as reference to measure movement of each tooth. FIG. 1B shows an analysis of the performance of one or more dental appliances. "Achieved" movement is plotted against "Goal" movement in scatter graphs, and trend lines are generated. Scatter graphs are shown to demonstrate where all "scattered" data points are, and trend lines are generated to show the performance of the dental appliances. In one embodiment, trend lines are selected to be linear (they can be curvilinear); thus trend lines present as the "best fit" straight lines for all "scattered" data. The performance of the Aligners is represented as the slope of a trend line. The Y axis intercept models the incidental movement that occurs when wearing the Aligners. Predictability is measured by R.sup.2 that is obtained from a regression computation of "Achieved" and "Goal" data);

e') sending of an information message as a function of said comparison, the information message being related to the quality of the image acquired and/or to the position of the acquisition apparatus in relation to said arch and/or to the setting of the acquisition apparatus and/or to the opening of the mouth and/or to the wearing of a dental, preferably orthodontic, appliance (page 7, paragraph, [0103-0104] the initial digital data set, which may include both raw data from scanning operations and data representing surface models derived from the raw data, is processed to segment the tissue constituents from each other (step 120). In particular, in this step, data structures that digitally represent individual tooth crowns are produced. Advantageously, digital models of entire teeth are produced, including measured or extrapolated hidden surfaces and root structures. The desired final position of the teeth--that is, the desired and intended end result of orthodontic treatment--can be received from a clinician in the form of a prescription, can be calculated from basic orthodontic principles, or can be extrapolated computationally from a clinical prescription (step 130). With a specification of the desired final

positions of the teeth and a digital representation of the teeth themselves, the final position and surface geometry of each tooth can be specified (step 140) to form a complete model of the teeth at the desired end of treatment. Generally, in this step, the position of every tooth is specified. The result of this step is a set of digital data structures that represents an orthodontically correct repositioning of the modeled teeth relative to presumed-stable tissue. The teeth and tissue are both represented as digital data. Also page 7, paragraph, [0109] having calculated appliance definitions, the process 100 can proceed to the manufacturing step (step 180) in which appliances defined by the process are manufactured, or electronic or printed information is produced that can be used by a manual or automated process to define appliance configurations or changes to appliance configurations, and page 16, paragraph, [0204] for each of these paired combinations, a combined address can be created, with database assets in a "digital mailbox" associated with each address. Assets for each digital mailbox can include, but is not limited to: treatment plan information related to the case-treatment goal pairing, such as a text description of the treatment condition and goals, treatment precautions, treatment length estimates, doctor skill set requirements, prescription data, sample case data, and case difficulty. This data may be generated using expert opinion, computational algorithms, and/or historical case content. Finally page 25, paragraph, [0307] in this manner, in one embodiment, the process of generating a prescription for orthodontic treatments may be simplified such that, using existing template information or generating an appropriate template associated with a specific treatment goal, certain information may be retrieved and pre-filled into the prescription form template, for example, the information that is associated with the patient's initial orthodontic condition, while other relevant information may be prompted for input from the user. In one embodiment, the user may store the prescription information in the predefined template display format such that the

user may retrieve the predefined template display for future treatment of similar types of cases. In a further aspect, the predefined template display may be associated with a particular one or more of an indexed or categorized value or score of the patient's initial dental conditions, with the treatment goal, or with any other customizable characteristics, such that the user may retrieve the predefined template display for subsequent similar cases for treatment).

Regarding claim 2, Kuo discloses the method as claimed in claim 1, in which, in the step b'), at least one analysis tooth zone is identified that represents, at least partially, a tooth on said analysis image, and at least one value of a tooth attribute is determined for said at least one analysis tooth zone, and, in the step c'), the value for the image attribute is determined as a function of said tooth attribute value (see page 4, paragraphs, [0074-0075] in one embodiment, data driven analyzers may be applied. These data driven analyzers may incorporate a number of models such as parametric statistical models, non-parametric statistical models, clustering models, nearest neighbor models, regression methods, and engineered (artificial) neural networks. Prior to operation, data driven analyzers or models are built using one or more training sessions. The data used to build the analyzer or model in these sessions are typically referred to as training data. As data driven analyzers are developed by examining only training examples, the selection of the training data can significantly affect the accuracy and the learning speed of the data driven analyzer. One approach used heretofore generates a separate data set referred to as a test set for training purposes. The test set is used to avoid overfitting the model or analyzer to the training data. Overfitting refers to the situation where the analyzer has memorized the training data so well that it fails to fit or categorize unseen data. Typically, during the construction of the analyzer or model, the analyzer's performance is tested against the test set. The selection of the analyzer or model parameters is performed iteratively until the performance

of the analyzer in classifying the test set reaches an optimal point. At this point, the training process is completed. An alternative to using an independent training and test set is to use a methodology called cross-validation. Cross-validation can be used to determine parameter values for a parametric analyzer or model for a non-parametric analyzer. In cross-validation, a single training data set is selected. Next, a number of different analyzers or models are built by presenting different parts of the training data as test sets to the analyzers in an iterative process. The parameter or model structure is then determined on the basis of the combined performance of all models or analyzers. Under the cross-validation approach, the analyzer or model is typically retrained with data using the determined optimal model structure. In one embodiment, the data mining software 3 (FIG. 1A) can be a "spider" or "crawler" to grab data on the database 2 (FIG. 1A) for indexing. In one embodiment, clustering operations are performed to detect patterns in the data. In another embodiment, a neural network is used to recognize each pattern as the neural network is quite robust at recognizing dental treatment patterns. Once the treatment features have been characterized, the neural network then compares the input dental information with stored templates of treatment vocabulary known by the neural network recognizer, among others. The recognition models can include a Hidden Markov Model (HMM), a dynamic programming model, a neural network, a fuzzy logic, or a template matcher, among others. These models may be used singly or in combination. Also page 5, paragraph, [0085] the ability to study tooth-specific efficacy and product performance for large clusters of treatment outcomes enables statistically significant comparisons to be made between two or more populations of cases. In the event that the two clusters studied contain differences in treatment approach, appliance design, or manufacturing protocol, the differences seen in the performance of the product as exhibited by the data output, can be attributed to the approach, design, or

manufacturing protocol. The end result is a feedback mechanism that enables either the clinician or the manufacturer the ability to optimize the product design and usage based on performance data from a significantly large sample size using objective measurable data. Also page 6, paragraph, [0092] FIG. 1F shows another embodiment of a data mining system to generate proposed treatments. First, the system identifies/clusterizes (zone), patient histories having detailed follow-up (such as multiple high-resolution scans), based on detailed follow-up data, diagnosis, treatment parameters and outcomes, and demographic variables (40). Within each cluster, the system models discrepancies between intended position and actual positions obtained from follow-up data (42). Further, within each cluster, the system models risk for special undesirable outcomes (44). At a second tier of clustering, patient histories with less detailed follow-up data are clusterized based on available variables. The second-tier clustering is partial enough that each of the larger number of second tier clusters can either be assigned to clusters calculated in 40 or else considered a new cluster (46). The system refines step 42 models with additional records from step 46 clusters (48). It can also refine step 44 models with additional records from step 48 clusters (50). At a third tier of clustering, the system then assigns new patients to step 46 clusters based on diagnosis, demographic, and initial physical (52). Within each step 52 cluster, the system models expected discrepancies between intended position and actual positions (54). From step 54, the system uses revised expected position information where relevant (including 232 and 250, FIG. 2B) (67). Additionally, within each step 52 cluster, the system models risk for undesirable outcomes (56). From step 56, the system also flags cases that require special attention and clinical constraints (as in 204 and 160, FIGS. 2B and 2A) (69). The process then customizes treatment plan to each step 52 cluster (58). Next, the system iteratively collects data (61) and loops back to identify/clusterize patient histories (40). Additionally,

clusters can be revised and reassigned (63). The system also continually identifies clusters without good representation for additional follow-up analysis (65)).

Regarding claim 3, Kuo discloses the method as claimed in claim 1, in which, in the step b'), all said analysis tooth zones are identified, and at least one tooth attribute value is determined for each analysis tooth zone, and, in the step c'), the value for the image attribute is determined as a function of said tooth attribute values (see claim 1, also page 3, paragraphs, [0068-0075] In one embodiment, clinical parameters in steps such as 170 (FIG. 2A) and 232 (FIG. 2B) are made more precise by allowing for the statistical deviation of targeted from actual tooth position. For example, a subsequent movement target might be reduced because of a large calculated probability of currently targeted tooth movement not having been achieved adequately, with the result that there is a high probability the subsequent movement stage will need to complete work intended for an earlier stage. Similarly, targeted movement might overshoot desired positions especially in earlier stages so that expected actual movement is better controlled. This embodiment sacrifices the goal of minimizing round trip time in favor of achieving a higher probability of targeted end-stage outcome. This methodology is accomplished within treatment plans specific to clusters of similar patient cases. Table 1 shows grouping of teeth in one embodiment. The sign convention of tooth movements is indicated in Table 2. Different tooth movements of the selected 60 arches were demonstrated in Table 3 with performance sorted by descending order. The appliance performance can be broken into 4 separate groups: high (79-85%), average (60-68%), below average (52-55%), and inadequate (24-47%). Table 4 shows ranking of movement predictability. Predictability is broken into 3 groups: highly predictable (0.76-0.82), predictable (0.43-0.63) and unpredictable (0.10-0.30). For the particular set of data, for example, the findings are as follows: 1. Incisor intrusion, and anterior intrusion performance

are high. The range for incisor intrusion is about 1.7 mm, and for anterior intrusion is about 1.7 mm. These movements are highly predictable. Canine intrusion, incisor torque, incisor rotation and anterior torque performance are average. The range for canine intrusion is about 1.3 mm, for incisor torque is about 34 degrees, for incisor rotation is about 69 degrees, and for anterior torque is about 34 degrees. These movements are either predictable or highly predictable. 3. Bicuspid tipping, bicuspid mesialization, molar rotation, and posterior expansion performance are below average. The range for bicuspid mesialization is about 1 millimeter, for bicuspid tipping is about 19 degrees, for molar rotation is about 27 degrees and for posterior expansion is about 2.8 millimeters. Bicuspid tipping and mesialization are unpredictable, whereas the rest are predictable movements. 4. Anterior and incisor extrusion, round teeth and bicuspid rotation, canine tipping, molar distalization, and posterior torque performance are inadequate. The range of anterior extrusion is about 1.7 millimeters, for incisor extrusion is about 1.5 mm, for round teeth rotation is about 67 degrees, for bicuspid rotation is about 63 degrees, for canine tipping is about 26 degrees, for molar distalization is about 2 millimeters, and for posterior torque is about 43 degrees. All are unpredictable movements except bicuspid rotation which is predictable. In one embodiment, data driven analyzers may be applied. These data driven analyzers may incorporate a number of models such as parametric statistical models, non-parametric statistical models, clustering models, nearest neighbor models, regression methods, and engineered (artificial) neural networks. Prior to operation, data driven analyzers or models are built using one or more training sessions. The data used to build the analyzer or model in these sessions are typically referred to as training data. As data driven analyzers are developed by examining only training examples, the selection of the training data can significantly affect the accuracy and the learning speed of the data driven analyzer. One approach used heretofore generates a separate

data set referred to as a test set for training purposes. The test set is used to avoid overfitting the model or analyzer to the training data. Overfitting refers to the situation where the analyzer has memorized the training data so well that it fails to fit or categorize unseen data. Typically, during the construction of the analyzer or model, the analyzer's performance is tested against the test set. The selection of the analyzer or model parameters is performed iteratively until the performance of the analyzer in classifying the test set reaches an optimal point. At this point, the training process is completed. An alternative to using an independent training and test set is to use a methodology called cross-validation. Cross-validation can be used to determine parameter values for a parametric analyzer or model for a non-parametric analyzer. In cross-validation, a single training data set is selected. Next, a number of different analyzers or models are built by presenting different parts of the training data as test sets to the analyzers in an iterative process. The parameter or model structure is then determined on the basis of the combined performance of all models or analyzers. Under the cross-validation approach, the analyzer or model is typically retrained with data using the determined optimal model structure and paragraph [0075].

Regarding claim 4, Kuo discloses the method as claimed in claim 2, in which the step b') comprises the following steps: 1) preferably before the step a'), creation of a learning base comprising more than 1000 images of dental arches, or "historical images", each historical image comprising one or more zones each representing a tooth, or "historical tooth zones", to each of which, for said tooth attribute, a tooth attribute value is assigned (see page 6, paragraph, [0092] FIG. 1F shows another embodiment of a data mining system to generate proposed treatments. First, the system identifies/clusterizes patient histories having detailed follow-up (such as multiple high-resolution scans), based on detailed follow-up data, diagnosis, treatment parameters and outcomes, and demographic variables (40). Within each cluster, the system

models discrepancies between intended position and actual positions obtained from follow-up data (42). Further, within each cluster, the system models risk for special undesirable outcomes (44). At a second tier of clustering, patient histories with less detailed follow-up data are clusterized based on available variables. The second-tier clustering is partial enough that each of the larger number of second tier clusters can either be assigned to clusters calculated in 40 or else considered a new cluster (46). The system refines step 42 models with additional records from step 46 clusters (48). It can also refine step 44 models with additional records from step 48 clusters (50). At a third tier of clustering, the system then assigns new patients to step 46 clusters based on diagnosis, demographic, and initial physical (52). Within each step 52 cluster, the system models expected discrepancies between intended position and actual positions (54). From step 54, the system uses revised expected position information where relevant (including 232 and 250, FIG. 2B) (67). Additionally, within each step 52 cluster, the system models risk for undesirable outcomes (56). From step 56, the system also flags cases that require special attention and clinical constraints (as in 204 and 160, FIGS. 2B and 2A) (69). The process then customizes treatment plan to each step 52 cluster (58). Next, the system iteratively collects data (61) and loops back to identify/clusterize patient histories (40). Additionally, clusters can be revised and reassigned (63). The system also continually identifies clusters without good representation for additional follow-up analysis (65). Also page 12, paragraph, [0150] referring to FIG. 12, the number of options field 1204 in one embodiment includes the number of possible reference conditions in each category, and also a total number of possible combinations of reference conditions. For example, the sagittal category has seven (7) possible reference conditions for the canine relationship component and the vertical category has seven (7) reference conditions for the anterior overbite component. The example shown yields

7.times.7.times.7.times.7=2401 possible combinations of reference conditions for the four components, as shown in table 1200 of FIG. 12. In one embodiment, each of these 2,401 patient case combinations is stored in a database in storage unit 1107 (FIG. 11), for example, by the central server 1109. Since there can be numerous components used to describe each of the four main orthodontic dimensions and not just one component per dimension as illustrated, in practice, the total number of combinations that can be used to describe a patient may be substantially higher, but at the same time, will be a finite number such that it may be indexed, catalogued, and queried as described in FIG. 11);

2) training of at least one deep learning device, preferably a neural network, by means of the learning base (see pages 4-5, paragraphs, [00740075] in one embodiment, data driven analyzers may be applied. These data driven analyzers may incorporate a number of models such as parametric statistical models, non-parametric statistical models, clustering models, nearest neighbor models, regression methods, and engineered (artificial) neural networks. Prior to operation, data driven analyzers or models are built using one or more training sessions. The data used to build the analyzer or model in these sessions are typically referred to as training data. As data driven analyzers are developed by examining only training examples, the selection of the training data can significantly affect the accuracy and the learning speed of the data driven analyzer. One approach used heretofore generates a separate data set referred to as a test set for training purposes. The test set is used to avoid overfitting the model or analyzer to the training data. Overfitting refers to the situation where the analyzer has memorized the training data so well that it fails to fit or categorize unseen data. Typically, during the construction of the analyzer or model, the analyzer's performance is tested against the test set. The selection of the analyzer or model parameters is performed iteratively until the performance of the analyzer in

classifying the test set reaches an optimal point. At this point, the training process is completed. An alternative to using an independent training and test set is to use a methodology called cross-validation. Cross-validation can be used to determine parameter values for a parametric analyzer or model for a non-parametric analyzer. In cross-validation, a single training data set is selected. Next, a number of different analyzers or models are built by presenting different parts of the training data as test sets to the analyzers in an iterative process. The parameter or model structure is then determined on the basis of the combined performance of all models or analyzers. Under the cross-validation approach, the analyzer or model is typically retrained with data using the determined optimal model structure. In one embodiment, the data mining software 3 (FIG. 1A) can be a "spider" or "crawler" to grab data on the database 2 (FIG. 1A) for indexing. In one embodiment, clustering operations are performed to detect patterns in the data. In another embodiment, a neural network is used to recognize each pattern as the neural network is quite robust at recognizing dental treatment patterns. Once the treatment features have been characterized, the neural network then compares the input dental information with stored templates of treatment vocabulary known by the neural network recognizer, among others. The recognition models can include a Hidden Markov Model (HMM), a dynamic programming model, a neural network, a fuzzy logic, or a template matcher, among others. These models may be used singly or in combination);

3) submission of the analysis image to the deep learning device for it to determine at least one probability relating to: the presence, at a location in said analysis image, of a zone representing, at least partially, a tooth, or "analysis tooth zone", the attribute value of the tooth represented on said analysis tooth zone, 4) determination, as a function of said probability, of the presence of a tooth at a position represented by said analysis tooth zone, and of the attribute

value of said tooth (see above claims, also page 5, paragraphs, [0079-0080] in the preferred embodiment, the Markov model is used to model probabilities for sequences of treatment observations. The transitions between states are represented by a transition matrix A=[a(i,j)]. Each a(i,j) term of the transition matrix is the probability of making a transition to state j given that the model is in state i. The output symbol probability of the model is represented by a set of functions B=[b(j), where the b(j) term of the output symbol matrix is the function that when evaluated on a specified value O(t) returns the probability of outputting observation O(t), given that the model is in state j. The first state is always constrained to be the initial state for the first time frame of the Markov chain, only a prescribed set of left to right state transitions are possible. A predetermined final state is defined from which transitions to other states cannot occur. In one embodiment, transitions are restricted to reentry of a state or entry to one of the next two states. Such transitions are defined in the model as transition probabilities. For example, a treatment pattern currently having a frame of feature signals in state 2 has a probability of reentering state 2 of a(2,2), a probability a(2,3) of entering state 3 and a probability of a(2,4)=1-a(2,2)-a(2,3) of entering state 4. The probability a(2,1) of entering state 1 or the probability a(2,5) of entering state 5 is zero and the sum of the probabilities a(2,1) through a(2,5) is one. Although the preferred embodiment restricts the flow graphs to the present state or to the next two states, one skilled in the art can build an HMM model with more flexible transition restrictions, although the sum of all the probabilities of transitioning from any state must still add up to one).

Regarding claim 5, Kuo discloses the method as claimed in claim 4, in which said tooth attribute is chosen from a tooth number, a tooth type, a tooth shape parameter, a tooth appearance parameter, a parameter relating to the state of the tooth, an age for the patient, or a

combination of these attributes (see page 12, paragraph, [0157] For example, consider the following patient identifier 1:NNABN. The identifier 1:NNABN would represent: tooth number 1 of a 32-bit address which has a natural mesial surface (subaddress position 1), an occlusal amalgam (subaddress position 2), a natural distal surface (subaddress position 3), a buccal/facial composite (subaddress position 4), and a natural lingual surface (subaddress position 5). Also page 13, paragraph, [0167] treatment Goal 4: Optimal set-up--the objective of this goal is to make the entire bite close to "textbook" ideal, including both the “canine and molar function”. Also page 19-20, paragraphs [0246] and [0267], more specifically, referring back to step 2930 at (3A), in one embodiment, one or more predefined treatment goals may be provided to the user (doctor, clinician or the patient) based on the patient's initial dental parameters. In such embodiment, the predefined treatment goals may include common treatment goals associated with the patient's initial dental parameters. For example, some predefined treatment goals are "pre-restorative setup", which involves aligning the teeth in anticipation of future dental work on the teeth following one or more orthodontic treatments; "esthetic alignment", which involves aligning the teeth for cosmetic improvement without altering the posterior bite relationship; "anterior function improvement", which involves aligning the teeth for improvement of the function and guiding relationship from the anterior teeth; and "optimal set-up", which involves aligning the teeth to provide as optimal of a bite relationship as possible given the patient's current initial dental characteristics).

Regarding claim 6, Kuo discloses the method as claimed in claim 1, in which the step b') comprises the following steps: 1') creation of a learning base comprising more than 1000 images of dental arches, or "historical images", each historical image comprising an attribute value for at least one image attribute, or "image attribute value"; 2') training of at least one deep learning

device, preferably a neural network, by means of the learning base; 3') submission of the analysis image to the deep learning device for it to determine, for said analysis image, at least one probability relating to said image attribute value (see claims 1 and 4, also (see page 6, paragraph, [0092] FIG. 1F shows another embodiment of a data mining system to generate proposed treatments. First, the system identifies/clusterizes patient histories having detailed follow-up (such as multiple high-resolution scans), based on detailed follow-up data, diagnosis, treatment parameters and outcomes, and demographic variables (40). Within each cluster, the system models discrepancies between intended position and actual positions obtained from follow-up data (42). Further, within each cluster, the system models risk for special undesirable outcomes (44). At a second tier of clustering, patient histories with less detailed follow-up data are clusterized based on available variables. The second-tier clustering is partial enough that each of the larger number of second tier clusters can either be assigned to clusters calculated in 40 or else considered a new cluster (46). The system refines step 42 models with additional records from step 46 clusters (48). It can also refine step 44 models with additional records from step 48 clusters (50). At a third tier of clustering, the system then assigns new patients to step 46 clusters based on diagnosis, demographic, and initial physical (52). Within each step 52 cluster, the system models expected discrepancies between intended position and actual positions (54). From step 54, the system uses revised expected position information where relevant (including 232 and 250, FIG. 2B) (67). Additionally, within each step 52 cluster, the system models risk for undesirable outcomes (56). From step 56, the system also flags cases that require special attention and clinical constraints (as in 204 and 160, FIGS. 2B and 2A) (69). The process then customizes treatment plan to each step 52 cluster (58). Next, the system iteratively collects data (61) and loops back to identify/clusterize patient histories (40). Additionally, clusters can be

revised and reassigned (63). The system also continually identifies clusters without good representation for additional follow-up analysis (65). Also page 12, paragraph, [0150] referring to FIG. 12, the number of options field 1204 in one embodiment includes the number of possible reference conditions in each category, and also a total number of possible combinations of reference conditions. For example, the sagittal category has seven (7) possible reference conditions for the canine relationship component and the vertical category has seven (7) reference conditions for the anterior overbite component. The example shown yields 7.times.7.times.7.times.7=2401 possible combinations of reference conditions for the four components, as shown in table 1200 of FIG. 12. In one embodiment, each of these 2,401 patient case combinations is stored in a database in storage unit 1107 (FIG. 11), for example, by the central server 1109. Since there can be numerous components used to describe each of the four main orthodontic dimensions and not just one component per dimension as illustrated, in practice, the total number of combinations that can be used to describe a patient may be substantially higher, but at the same time, will be a finite number such that it may be indexed, catalogued, and queried as described in FIG. 11).

Regarding claim 7, Kuo discloses the method as claimed in claim 4, in which, in the step 1) or 1'), a learning base is created comprising more than 10 000 historical images (see claim 4, also page 16, paragraph, [0202] in this arrangement, the first four positions "A" to "D" of the matrix represent the patient's initial dentition (as previously described), positions "A*" to "D*" of the matrix represent the patient's target dentition or treatment goal, and positions "A**" to "D**" of the matrix represent the patient's actual final dentition or treatment outcome. Because the number of positions in the matrix may be variable, and since each position can include symbols, alphanumeric characters or other representations, the depth of individual patient cases

that is stored is may be detailed and specific to the patient and/or the associated profile or condition. Using the 4 possible treatment outcomes illustrated in FIG. 14 and the 2,701 possible combinations in FIG. 12, this equates to 2,701.times.4=10,804 possible paired combinations between initial and goal).

With regard to claims 8-10 the arguments analogous to those presented above for claims 12, 3, 4, 5, 6 and 7 are respectively applicable to claims 8-10.

Claim Rejections - 35 USC § 103

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 11-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kuo (U.S. Pub No: 2015/0132708 A1) in view of Borovinskih et al (Pub. No: U.S. 2017/0049311 A1).

Regarding claim 11, Kuo discloses (see page 16, paragraph, [0206] FIG. 28 illustrates a process 2800 for identifying a dentition problem or condition of a patient. The process 2800 is discussed more fully in conjunction with FIGS. 16-27. At step 2801, the user starts by entering identification information such as doctor and patient name, in addition to patient chief concern(s) (FIG. 16). In one embodiment, this comparison may be performed by the central server 1109 (FIG. 11) based on information received, for example, from the terminal 1101, and/or based on stored information retrieved from the data storage unit 1107. This and other related transactions in the process may be performed over a data network such as the internet via a secure

connection. The user then selects one of two user interfaces to input the patient's dental condition. The preferred method for the novice user is the visual-user interface (FIG. 17-22) shown as step 2802. The advanced user will likely prefer the alternative user interface (FIG. 25) illustrated as step 2803).

But does not explicitly state, limitation of claim "the acquisition apparatus is a cellphone".

On the other hand "Borovinskih", in the same field of "photograph-based assessment of dental treatments and procedures", teaches (page 4, paragraph, [0036] FIGS. 5A-D graphically illustrate the treatment-monitoring method to which the current document is, in part, directed. As shown in FIG. 5A, at a particular current point in time, t.sub.82, during a dental patient's treatment or procedure, represented in FIG. 5A by vertical arrow 502, a dental practitioner examines the patient and takes a number n of two-dimensional pictures of the patient's teeth 504. Alternatively, in certain implementations, the two-dimensional pictures may be taken by a patient's friend or relative, or even the patient, using a camera timer or smart-phone features that facilitate acquisition of images of a user. In the current example, n is equal to 3. In general, each photograph or subset of the photographs represents a certain, standard view or image type. A dental practitioner or other person is provided with instructions for capturing an image of a particular standard view or type. As shown in FIG. 5B, once the practitioner has submitted these two-dimensional images, along with patient information, an indication of the time that the two-dimensional images were captured, and other such information, the treatment-monitoring system, to which the current document is, in part, directed, determines camera parameters for virtual cameras 506-508, the orientations and positions of which most likely correspond to the camera parameters of the dental practitioner's camera at the points in time at which each of the corresponding n two-dimensional pictures, 510-512, respectively, were captured by the dental

practitioner or other person).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the Kuo invention according to the teaching of Borovinskih because to combine "the central server to be configured to communicate with the terminal and data storage unit to access software stored in the data storage unit that may be performed over the internet that is taught by the Kuo invention according to the teaching taught by Borovinskih, using a smart phone and camera to capture dental images would provide for an improved method and system of acquiring and transmitting dental images, information, and messages captured with a camera in a smart (cell) phone and sent via the internet.

Regarding claim 12, Kuo discloses the method as claimed in claim 1, in which the information message is sent by the acquisition apparatus (see claim 11, also page 16, paragraph, [0199] FIG. 25 illustrates an alternate embodiment of the present invention for capturing an address in the selection process for use in the indexing system. FIG. 25 illustrates the table 1200 of FIG. 12 used directly as a graphical interface. In such embodiment, each reference condition as shown and illustrated in tabular format as rectangles may be represented as user input buttons with text which may be clicked to highlight and select the appropriate reference condition. The assumption for this type of interface is that the user understands the definitions of the text in order to select the appropriate button. When the buttons are pressed to select a particular reference condition, the selections are highlighted (shown in bold in FIG. 25). Clicking any button twice will deselect the initial selection so that another selection can be made. In this manner, users who are more familiar with the various types of reference conditions may be able to input the information more quickly than through a visual-image based interface. In this example, the generated address would be "3256." The "Selected Value" column on the right side

of FIG. 25 is in one embodiment, transparent to the user/patient, and not displayed to the user since the address has no relevance to the end user, and is important only for the database query. Also paragraph, [0204] for each of these paired combinations, a combined address can be created, with database assets in a "digital mailbox" associated with each address. Assets for each digital mailbox can include, but is not limited to: treatment plan information related to the case-treatment goal pairing, such as a text description of the treatment condition and goals, treatment precautions, treatment length estimates, doctor skill set requirements, prescription data, sample case data, and case difficulty. This data may be generated using expert opinion, computational algorithms, and/or historical case content).

Regarding claim 13, Kuo discloses the method as claimed in claims 1, in which said image attribute relates to a position and/or an orientation and/or a calibration of an acquisition apparatus used to acquire said analysis image, and/or a quality of the analysis image, and in particular relating to the brightness, to the contrast or to the sharpness of the analysis image, and/or the content of the analysis image, in particular to the representation of the arches, of the tongue, of the mouth, of the lips, of the jaws, of the gums, of one or more teeth or of an orthodontic appliance (see claims 1 and 11, also page 7, paragraphs, [0101-0102] FIG. 2A illustrates the general flow of an exemplary process 100 for defining and generating repositioning appliances for orthodontic treatment of a patient. The process 100 includes the methods, and is suitable for the apparatus, of the present invention, as will be described. The computational steps of the process are advantageously implemented as computer program modules for execution on one or more conventional digital computers. As an initial step, a mold or a scan of patient's teeth or mouth tissue is acquired (110). This step generally involves taking casts of the patient's teeth and gums, and may in addition or alternately involve taking wax bites,

direct contact scanning, x-ray imaging, tomographic imaging, sonographic imaging, and other techniques for obtaining information about the position and structure of the teeth, jaws, gums and other orthodontically relevant tissue. From the data so obtained, a digital data set is derived that represents the initial (that is, pretreatment) arrangement of the patient's teeth and other tissues).

Contact Information

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Seyed Azarian whose telephone number is (571) 272-7443. The examiner can normally be reached on Monday through Thursday from 6:00 a.m. to 7:30 p.m.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Bella, can be reached at (571) 272-7778. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application information Retrieval (PAIR) system. Status information for published application may be obtained from either Private PAIR or Public PAIR.

Status information about the PAIR system, see http:// pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

/SEYED H AZARIAN/
Primary Examiner, Art Unit 2667
December 5, 2019

EXHIBIT OP-4

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/921,545	07/06/2020	Philippe SALAH	N&P-51400US1	8521

108676 7590 01/12/2022
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EXAMINER	
HASAN, MAINUL	

ART UNIT	PAPER NUMBER
2485	

NOTIFICATION DATE	DELIVERY MODE
01/12/2022	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

docketing@cooperlegalgroup.com

PTOL-90A (Rev. 04/07)

Office Action Summary	Application No. 16/921,545	Applicant(s) SALAH et al.	
	Examiner MAINUL HASAN	Art Unit 2485	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 30 December 2021.
☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-20 is/are pending in the application.
5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-20 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☑ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 16 March 2021 is/are: a)☑ accepted or b)☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
Certified copies:
a)☑ All b)☐ Some** c)☐ None of the:
1.☑ Certified copies of the priority documents have been received.
2.☐ Certified copies of the priority documents have been received in Application No. _____.
3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b)
Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA. In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status. There are a total of 20 claims and claims 1-20 are pending.

Examiner's Response to Preliminary Amendments

The Examiner acknowledges and enters for consideration the Preliminary Claim Amendments filed on 07/06/2020 and Preliminary Drawing Amendments filed on 03/16/2021. Claims 21-64 have been cancelled. Claims 1-20 remain pending in the current application.

Priority

Acknowledgment is made of applicant's claim for foreign priority based on an application filed in FR1753392 on 04/19/2017, FR1753389 04/19/2017, and EP17306361.1 10/10/2017. Receipt is acknowledged of certified copies of papers required by 37 CFR 1.55.

Claim Objections

Claim 7 is objected to because of the following informalities:

Claim 7 recites "…*which extends between two end faces defining said first opening and said second opening* ***to***". It is not clear what the word "to" is contributing to the limitation. The Examiner believes the word should be removed.

Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of 35 U.S.C. 112(b):

(B) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

The following is a quotation of 35 U.S.C. 112, second paragraph:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 8, 20 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor (or for applications subject to pre-AIA 35 U.S.C. 112, the applicant), regards as the invention.

The term "substantially" in claims 8, 20 is a relative term which renders the claim indefinite. The term "substantially" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention.

Double Patenting

The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on nonstatutory double patenting provided the reference application or patent either is shown to be commonly owned with the examined application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP § 2146 *et seq.* for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/patent/patents-forms. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or

PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

Claims **1-12** are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-17 of U.S. Patent No. **10,736,715 B2**. Although the claims at issue are not identical, they are not patentably distinct from each other because of the following reasons.

Claim **1** of the instant application is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 1 of U.S. Patent No. **10,736,715 B2**. Although the claims at issue are not identical, they are not patentably distinct from each other because of the following reasons:

	16921545 (Instant Application)	**10,736,715 B2** (Patent)
	Claim 1	**Claim 1**
1	*A method to **acquire dental images of a patient with a support defining a chamber that is in communication with an outside of said chamber via a first opening and via a second opening**, said method comprising the following steps:*	*An imaging device including:*
2	- ***fixing a mobile phone in front of the second opening;***	***a support;***
3	- ***positioning said first opening in front of a mouth of the patient;***	***a mouth retractor fastened to the support and defining a retractor opening; and***
4	- ***acquiring at least one dental image by means of the mobile phone.***	***a mechanism for fastening an image acquisition apparatus to the support in a position in which the acquisition apparatus is oriented so as to receive an image of the retractor opening,***

5		***wherein the support takes the form of a box that is in communication with the outside via the retractor opening and via an acquisition opening through which the acquisition apparatus fastened to the support receives said image of the retractor opening,***
6		*the support being configured so that the acquisition apparatus observes the retractor opening regardless of a configuration of said support,*
7		*said mechanism being chosen from the group consisting of clip-fastening means, self-gripping strips of hook and loop fastener type, clamping jaws, screws, magnets, and complementarity of shape between the support and the acquisition apparatus, or consisting of a cover that may be clamped against the support.*

The equivalence in claim limitations of the instant application and the patent are highlighted in **bold** texts. Although the instant application claim limitations appear to be a broader version of the corresponding Patent claim limitation, however, a close review shows that the limitations are identical. Although the instant application claims a method and the Patent claims a device, however, they are not patentable different from each other because of the following explanation: The method describes dental image acquisition of a patient by a support defining a chamber having a first end a second end for communicating with the outside. The Patent describes an imaging device having a support in the shape of a box (chamber of instant application) that communicates with the outside through a retractor opening (first opening of instant application) and an acquisition opening (second opening of instant application). The method also describes fixing a mobile phone in front of the second opening. The Patent describes an image acquisition apparatus (mobile phone of instant application since the mobile phone is

exclusively used for acquiring an image) which is placed at the acquisition opening through which the acquisition apparatus fastened to the support receives said image. The method then describes positioning the first opening in front of a mouth of the patient. The Patent describes a mouth retractor (which goes in to retract the patient's mouth) fastened to the support and defining a retractor opening (first opening of the instant application). Lastly, the method describes acquiring a dental image by means of the mobile phone. The Patent describes the acquisition apparatus (mobile phone) fastened to the support receives said image of the retractor opening (acquires dental image of the mouth). Therefore, the instant application claim 1 as a whole is not patentable over the Patent claim 1. This is a non-statutory double patenting rejection.

Claims **2-12** of the instant application are rejected on the ground of nonstatutory double patenting as being unpatentable over a combination of claims of U.S. Patent No. **10,736,715 B2**.

Claims **13-20** are rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-17 of U.S. Patent No. **10,736,715 B2** in view of **Dorodvand et al. (US PGPub 2019/0167115 A1) (Disclosed in IDS)**. Although the claims at issue are not identical, the instant application claim is not patentable over the Patent claims in view of **Dorodvand et al**.

Claim **13** of the instant application is rejected on the ground of nonstatutory obviousness type double patenting as being unpatentable over claim 1 of U.S. Patent No. **10,736,715 B2** in view of **Dorodvand et al. (US PGPub 2019/0167115 A1) (Disclosed in IDS)**. Although the

claims at issue are not identical, the instant application claim is not patentable over the Patent claim in view of **Dorodvand et al.** as shown in the following table:

	16921545 (Instant Application)	**10,736,715 B2** (Patent)
	Claim 13	**Claim 1**
1	*a method to* ***acquire dental images of a patient with a support defining a chamber that is in communication with an outside of said chamber via a first opening and via a second opening,*** *the distance between said openings being constant, said method comprising the following steps:*	***An imaging device including:***
2	***- fixing a mobile phone in front of the second opening, in one predetermined position,***	***a support;***
3	***- positioning a mouth of the patient in front of the first opening;***	***a mouth retractor fastened to the support and defining a retractor opening; and***
4	***- acquiring, by the patient, at least one dental image by means of the mobile phone.***	***a mechanism for fastening an image acquisition apparatus to the support in a position in which the acquisition apparatus is oriented so as to receive an image of the retractor opening,***
5		***wherein the support takes the form of a box that is in communication with the outside via the retractor opening and via an acquisition opening through which the acquisition apparatus fastened to the support receives said image of the retractor opening,***
6		*the support being configured so that the acquisition apparatus observes the retractor opening regardless of a configuration of said support,*

7		*said mechanism being chosen from the group consisting of clip-fastening means, self-gripping strips of hook and loop fastener type, clamping jaws, screws, magnets, and complementarity of shape between the support and the acquisition apparatus, or consisting of a cover that may be clamped against the support.*

The equivalence in claim limitations of the instant application and the patent are highlighted in **bold** texts. Although the instant application claim limitations appear to be a broader version of the corresponding Patent claim limitation, however, a close review shows that the limitations are identical except the limitation of the distance between the first opening and second opening being constant, which is not present in the Patent. The rest of the instant application limitations are identical to the Patent limitations (Please see the explanation for claim 1 DP rejection above). However, **Dorodvand et al.** teach a system in the same field of endeavor **(Abstract)**, where it teaches the limitation of the distance between the first opening and second opening being constant **(Dorodvand et al.; [0042], L1-8)**. It would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to combine the Patent's invention of a dental imaging device to include **Dorodvand et al**'s usage of constant distance between the image acquisition device and the mouth, because the image area is therefore constant between images. Similarly the distance of the image capture device from the teeth and gums is constant providing a consistent focal length and rotation between images **(Dorodvand et al.; [0042], L1-8)**. Therefore, the instant application claim 13 as a whole is not patentable over the patent claim 1 in view of **Dorodvand et al.** This is a non-statutory obviousness type double patenting rejection.

Claims **14-20** of the instant application are rejected on the ground of nonstatutory obviousness type double patenting as being unpatentable over a combination of claims of U.S. Patent No. **10,736,715 B2** in view of **Dorodvand et al. (US PGPub 2019/0167115 A1) (Disclosed in IDS)**.

Claims **1-12** of the instant application are also rejected on the ground of nonstatutory double patenting as being unpatentable over claims 1-21 of U.S. Patent No. **10,842,592 B2**.

Claim **1** of the instant application is rejected on the ground of nonstatutory double patenting as being unpatentable over claim 1 of U.S. Patent No. **10,842,592 B2**. Although the claims at issue are not identical, they are not patentably distinct from each other because of the following reasons:

	16921545 (Instant Application)	**10,842,592 B2** (Patent)
	Claim 1	**Claim 1**
1	*A method to* ***acquire dental images of a patient with a support defining a chamber that is in communication with an outside of said chamber via a first opening and via a second opening****, said method comprising the following steps:*	***An imaging device including:***
2	*-* ***fixing a mobile phone in front of the second opening;***	***a support;***
3	*-* ***positioning said first opening in front of a mouth of the patient;***	***a mouth retractor fastened, to the support and defining a retractor opening****, the mouth retractor including a rim extending around the retractor opening; a colorimetric calibration chart and/or a translucence calibration chart; and a light source that is oriented so as to illuminate both teeth of a patient through the retractor opening and said colorimetric calibration chart and/or said translucence calibration chart;*

4	- ***acquiring at least one dental image by means of the mobile phone***.	***means for fastening an image acquisition apparatus to the support in a position in which the image acquisition apparatus is oriented so as to receive an image of*** *both* ***the retractor opening*** *and of said colorimetric calibration chart and/or of said translucence calibration chart,*
5		*wherein said means for fastening can be deactivated, the mouth retractor being configured so as, in a service position in which the* ***mouth retractor is positioned on the mouth of a patient****, lips of the patient may rest on said rim so that only an inside of the mouth is visible through the retractor opening;*
6		***the support taking the form of a box, that is in communication with the outside via the retractor opening and via an acquisition opening through which the acquisition apparatus fastened to the support receives said image of the retractor opening,***
7		***the support being configured so that the acquisition apparatus observes the retractor opening regardless of a configuration of said support;*** ***the image acquisition apparatus being a mobile phone or a tablet.***

The equivalence in claim limitations of the instant application and the patent are highlighted in **bold** texts. Although the instant application claim limitations appear to be a broader version of the corresponding Patent claim limitation, however, a close review shows that the limitations are identical. Although the instant application claims a method and the Patent claims a device, however, they are not patentable different from each other because of the following explanation: The method describes dental image acquisition of a patient by a support

defining a chamber having a first end a second end for communicating with the outside. The Patent describes an imaging device having a support in the shape of a box (chamber of instant application) that communicates with the outside through a retractor opening (first opening of instant application) and an acquisition opening (second opening of instant application). The method also describes fixing a mobile phone in front of the second opening. The Patent describes the image acquisition apparatus being a mobile phone or a tablet which is placed at the acquisition opening (second opening of instant application) through which the acquisition apparatus fastened to the support receives said image. The method then describes positioning the first opening in front of a mouth of the patient. The Patent describes a mouth retractor (which goes in to retract the patient's mouth) wherein the mouth retractor is positioned on the mouth of a patient, and fastened to the support and defining a retractor opening (first opening of the instant application). Lastly, the method describes acquiring a dental image by means of the mobile phone. The Patent describes the acquisition apparatus (mobile phone) fastened to the support receives said image of the retractor opening (acquires dental image of the mouth). Therefore, the instant application claim 1 as a whole is not patentable over the Patent claim 1. This is a non-statutory double patenting rejection.

Claims **2-12** of the instant application are also rejected on the ground of nonstatutory double patenting as being unpatentable over a combination of claims of U.S. Patent No. **10, 842,592 B2**.

Claim **13** of the instant application is rejected on the ground of nonstatutory obviousness type double patenting as being unpatentable over claim 1 of U.S. Patent No. **10,842,592 B2** in view of **Dorodvand et al. (US PGPub 2019/0167115 A1)** **(Disclosed in IDS)**. Although the

claims at issue are not identical, the instant application claim is not patentable over the Patent claim in view of **Dorodvand et al.** as shown in the following table:

	16921545 (Instant Application)	**10,842,592 B2** (Patent)
	Claim 13	**Claim 1**
1	*a method to **acquire dental images of a patient with a support defining a chamber that is in communication with an outside of said chamber via a first opening and via a second opening**, the distance between said openings being constant, said method comprising the following steps:*	***An imaging device including:***
2	***- fixing a mobile phone in front of the second opening, in one predetermined position,***	***a support;***
3	***- positioning a mouth of the patient in front of the first opening;***	***a mouth retractor fastened**, **to the support and defining a retractor opening**, the mouth retractor including a rim extending around the retractor opening; a colorimetric calibration chart and/or a translucence calibration chart; and a light source that is oriented so as to illuminate both teeth of a patient through the retractor opening and said colorimetric calibration chart and/or said translucence calibration chart;*
4	***- acquiring, by the patient, at least one dental image by means of the mobile phone.***	***means for fastening an image acquisition apparatus to the support in a position in which the image acquisition apparatus is oriented so as to receive an image of** both **the retractor opening** and of said colorimetric calibration chart and/or of said translucence calibration chart,*
5		*wherein said means for fastening can be deactivated, the mouth retractor being configured so as, in a service position in which the **mouth retractor is positioned on the mouth of a patient**, lips of the patient may rest on said rim so that only an inside*

		of the mouth is visible through the retractor opening;
6		***the support taking the form of a box, that is in communication with the outside via the retractor opening and via an acquisition opening through which the acquisition apparatus fastened to the support receives said image of the retractor opening,***
7		***the support being configured so that the acquisition apparatus observes the retractor opening regardless of a configuration of said support; the image acquisition apparatus being a mobile phone or a tablet.***

The equivalence in claim limitations of the instant application and the patent are highlighted in **bold** texts. Although the instant application claim limitations appear to be a broader version of the corresponding Patent claim limitation, however, a close review shows that the limitations are identical except the limitation of the distance between the first opening and second opening being constant, which is not present in the Patent. The rest of the instant application limitations are identical to the Patent limitations (Please see the explanation for claim 1 DP rejection above). However, **Dorodvand et al.** teach a system in the same field of endeavor **(Abstract)**, where it teaches the limitation of the distance between the first opening and second opening being constant **(Dorodvand et al.; [0042], L1-8)**. It would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to combine the Patent's invention of a dental imaging device to include **Dorodvand et al**'s usage of constant distance between the image acquisition device and the mouth, because the image area is

therefore constant between images. Similarly the distance of the image capture device from the teeth and gums is constant providing a consistent focal length and rotation between images (**Dorodvand et al.; [0042], L1-8**). Therefore, the instant application claim 13 as a whole is not patentable over the patent claim 1 in view of **Dorodvand et al.** This is a non-statutory obviousness type double patenting rejection.

Claims **14-20** of the instant application are also rejected on the ground of nonstatutory obviousness type double patenting as being unpatentable over a combination of claims of U.S. Patent No. **10, 842,592 B2** in view of **Dorodvand et al**.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a)(1) the claimed invention was patented, described in a printed publication, or in public use, on sale or otherwise available to the public before the effective filing date of the claimed invention.

Claims 1-6, 9-10 are rejected under AIA 35 U.S.C. 102(a)(1) as being anticipated by Prakash et al. (US PGPub 2013/0209954 A1).

Regarding claim **1** (Original), **Prakash et al.** disclose *a method to acquire dental images of a patient* **(Figs. 9A-F)** *with a support* **(Figs. 2A-C,** reference numeral **220. Figs. 5A-B,** reference numeral **520)** *defining a chamber* **(Fig. 5B,** reference numeral **520** shows the chamber which is a box shaped camera mount as the support) *that is in communication with an outside of*

said chamber via a first opening and via a second opening (**[0104], L5-10; Fig. 5C** shows the retractor or the mouthpiece **560** and a first opening **571** through which the image acquisition device or the cellphone camera receives the image for capturing and a second opening **561** which opens to the mouth)*, said method comprising the following steps:*

- *fixing a mobile phone in front of the second opening* (**Fig. 5B,** reference numeral **580; Fig. 5C,** reference numeral **584**)*;*

- *positioning said first opening in front of a mouth of the patient* (**Fig. 5B** shows the positioning of the mouthpiece's (**510**) other opening in front of the mouth. **Fig. 5C** also shows the first opening **571** through which the cellphone is mounted and second opening **561** which is positioned in front of the mouth)*;*

- *acquiring at least one dental image by means of the mobile phone* (**[0040]; Figs. 9A-F**).

Regarding claim **2** (Original), **Prakash et al.** disclose *the method as claimed in claim 1, comprising a step before acquiring at least one dental image, in which a dental retractor is introduced in the mouth of the patient* (**Fig. 5B,** reference numeral **510, Fig. 5C-D,** reference numeral **560** show the mouthpiece which acts as a mouth retractor before acquiring any images).

Regarding claim **3** (Original), **Prakash et al.** disclose *the method as claimed in claim 2, in which the dental retractor is fixed on the support in front of the first opening* (**Fig. 5C** shows the retractor **560** is fixed in front of the first opening **571**).

Regarding claim **4** (Original), **Prakash et al.** disclose *the method as claimed in claim 2, in which the dental retractor is formed as an integral part of the support* (**Figs. 2A-B,** reference numeral **210** is the mouthpiece or retractor and **211** is the opening. **Figs. 5A-B,** reference numeral **510** is the mouthpiece or retractor and **511** is the opening. To be specific, reference numerals **212a-b**, known as bite guides, on the mouthpiece **210** act as the mouth retractors as shown in **Fig. 2A**).

Regarding claim **5** (Original), **Prakash et al.** disclose *the method as claimed in claim 1, in which said positioning comprises a positioning of patient's lips on a rim extending around the first opening* (**Fig. 2A,** reference numerals **212a-b** and **Fig. 5A,** reference numerals **512** represent the bite guides which is equivalent to a rim that act as a spreader of the patient's lips as described in **[0004], L3-10.** Also, see **Fig. 10B,** reference numeral **1012**).

Regarding claim **6** (Original), **Prakash et al.** disclose *the method as claimed in claim 1, comprising an automatic guidance of a user to help positioning of the mouth relative to the support, and/or specifying a number of images to be acquired* (**[0045], L9-12**).

Regarding claim **9** (Original), **Prakash et al.** disclose *the method as claimed in claim 1, in which the support is rectangular in cross section* (**Fig. 5B** shows the camera mount **520** which is rectangular in cross-section).

Regarding claim **10** (Original), **Prakash et al.** disclose *the method as claimed in claim 1, in which the fixing of the mobile phone on the support is performed by fastening the mobile*

phone to the support in only one predetermined position (**[0062];** it discloses that the adjustable clips **226** enable the image acquisition device to be fastened to the mount **220** in different positions, however, it also discloses that in certain scenario, e.g., for a camera cell phone, the clips are not adjustable along a track, meaning the fastening of the camera is achieved only in one position).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103 which forms the basis for all obviousness rejections set forth in this Office action:

> A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 7, 11-20 are rejected under 35 U.S.C. 103 as being unpatentable over Prakash et al. (US PGPub 2013/0209954 A1) in view of Dorodvand et al. (US PGPub 2019/0167115 A1) (Disclosed in IDS).

Regarding claim **7** (Original), **Prakash et al.** teach *the method as claimed in claim 1, in which the support comprises lateral wall which extends between two end faces defining said first opening and said second opening to* (**Fig. 10A** shows the optical path opening **1023** created by the support wall (on two sides) which is laterally extended between the two openings).

Although, **Prakash et al.** teach determining distance from an imaging plane to a surface of an oral cavity of a subject as described in **[0010]**, but it does not explicitly teach that the distance between the two openings being constant.

However, **Dorodvand et al.** teach a system in the same field of endeavor **(Abstract)**, where it teaches the distance between the first opening and second opening being constant **(Dorodvand et al.; [0042], L1-8)**.

It would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to combine **Prakash et al**'s invention of a dental imaging device to include **Dorodvand et al**'s usage of constant distance between the image acquisition device and the mouth, because the image area is therefore constant between images and similarly the distance of the image capture device from the teeth and gums is constant providing a consistent focal length and rotation between images **(Dorodvand et al.; [0042], L1-8)**.

Regarding claim **11** (Original), **Prakash et al.** teach *the method as claimed in claim 1.*

Although, **Prakash et al.** teach acquiring images of a patient's oral cavity using a mobile phone camera mounted on a support attached to the mouth of the patient, but it does not explicitly teach *at least said acquiring of said at least one dental image is performed by the patient.*

However, **Dorodvand et al.** teach a system in the same field of endeavor **(Abstract)**, where it teaches acquisition of dental images being performed by the patient **(Dorodvand et al.; [0021], L16-22)**

It would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to combine **Prakash et al**'s invention of a dental imaging

device to include **Dorodvand et al**'s capability of patient performing the image acquisition, because the user may reliably and reproducibly capture images of their mouth, without the aid of a skilled operator **(Dorodvand et al.; [0020]**).

Regarding claim **12** (Original), **Prakash et al.** teach *the method as claimed in claim 1.*

But **Prakash et al.** do not explicitly teach *acquiring is performed in less than a minute, without recourse to a specialist.*

However, **Dorodvand et al.** teach a system in the same field of endeavor **(Abstract)**, where it teaches *acquiring is performed in less than a minute, without recourse to a specialist* **(Dorodvand et al.; [0017];** It teaches that the invention seeks to give instant feedback to a user regarding their oral health, which is less than a minute. On the other hand, it also teaches that the invention seeks to provide a straightforward method which can be implemented by an untrained user to provide a quick and accurate estimate of tooth).

It would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to combine **Prakash et al**'s invention of a dental imaging device to include **Dorodvand et al**'s capability of patient performing the image acquisition, because the user may reliably and reproducibly capture images of their mouth, without the aid of a skilled operator **(Dorodvand et al.; [0020]**).

Regarding claim **13** (Original), **Prakash et al.** teach *a method to acquire dental images of a patient* **(Figs. 9A-F)** *with a support* **(Figs. 2A-C,** reference numeral **220. Figs. 5A-B,** reference numeral **520)** *defining a chamber* **(Fig. 5B,** reference numeral **520** shows the chamber which is a box shaped camera mount as the support) *that is in communication with an outside of said*

chamber via a first opening and via a second opening (**[0104], L5-10; Fig. 5C** shows the retractor or the mouthpiece **560** and a first opening **571** through which the image acquisition device or the cellphone camera receives the image for capturing and a second opening **561** which opens to the mouth)*, the distance between said openings being constant, said method comprising the following steps:*

- fixing a mobile phone in front of the second opening, in one predetermined position (**Fig. 5B,** reference numeral **580; Fig. 5C,** reference numeral **584**. The predetermined position could be any of the three positions as shown in **Figs. 3A-C**),

- positioning a mouth of the patient in front of the first opening (**Fig. 5B** shows the positioning of the mouthpiece's (**510**) other opening in front of the mouth. **Fig. 5C** also shows the first opening **571** through which the cellphone is mounted and second opening **561** which is positioned in front of the mouth)*;*

- acquiring, by the patient, at least one dental image by means of the mobile phone (**[0040]; Figs. 9A-F;** In **[0108],** it teaches usage of the system by user/clinician. Here the user is analogous to a patient).

Although, **Prakash et al.** teach determining distance from an imaging plane to a surface of an oral cavity of a subject as described in **[0010]**, but it does not explicitly teach that the distance between the two openings being constant.

However, **Dorodvand et al.** teach a system in the same field of endeavor **(Abstract)**, where it teaches the distance between the first opening and second opening being constant (**Dorodvand et al.; [0042], L1-8**).

It would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to combine **Prakash et al**'s invention of a dental imaging

device to include **Dorodvand et al**'s usage of constant distance between the image acquisition device and the mouth, because the image area is therefore constant between images and similarly the distance of the image capture device from the teeth and gums is constant providing a consistent focal length and rotation between images (**Dorodvand et al.; [0042], L1-8**).

Regarding claim **14** (Original), **Prakash et al.** and **Dorodvand et al.** teach *the method as claimed in claim 13, in which said positioning comprises positioning of the patient's lip on a rim of the support* (**Prakash et al.; Fig. 2A,** reference numerals **212a-b** and **Fig. 5A,** reference numerals **512** represent the bite guides which is equivalent to a rim that act as a spreader of the patient's lips as described in **[0004], L3-10.** Also, see **Fig. 10B,** reference numeral **1012**).

Regarding claim **15** (Original), **Prakash et al.** and **Dorodvand et al.** teach *the method as claimed in claim 13, comprising a step before acquiring at least one dental image, in which a dental retractor is introduced in the mouth of the patient* (**Prakash et al.; Fig. 5B,** reference numeral **510, Fig. 5C-D,** reference numeral **560** show the mouthpiece which acts as a mouth retractor before acquiring any images).

Regarding claim **16** (Original), **Prakash et al.** and **Dorodvand et al.** teach *the method as claimed in claim 15, in which the dental retractor is fixed on the support in front of the first opening* (**Prakash et al.; Fig. 5C** shows the retractor **560** is fixed in front of the first opening **571**).

Regarding claim **17** (Original), **Prakash et al.** and **Dorodvand et al.** teach *the method as claimed in claim 15, in which the dental retractor is formed as an integral part of the support* **(Prakash et al.; Figs. 2A-B,** reference numeral **210** is the mouthpiece or retractor and **211** is the opening. **Figs. 5A-B,** reference numeral **510** is the mouthpiece or retractor and **511** is the opening. To be specific, reference numerals **212a-b**, known as bite guides, on the mouthpiece **210** act as the mouth retractors as shown in **Fig. 2A**).

Regarding claim **18** (Original), **Prakash et al.** and **Dorodvand et al.** teach *the method as claimed in claim 13, in which the patient is automatically guided for said positioning and/or is specified of a number of images to be acquired* (**Prakash et al.; [0045], L9-12**).

Regarding claim **19** (Original), **Prakash et al.** and **Dorodvand et al.** teach *the method as claimed in claim 13, in which the support comprises lateral wall which extends between two end faces* (**Prakash et al.; Fig. 10A** shows the optical path opening **1023** created by the support wall (on two sides) which is laterally extended between the two openings)

Regarding claim **20** (Original), **Prakash et al.** and **Dorodvand et al.** teach *the method as claimed in claim 19, in which the lateral wall is substantially cylindrical* (**Prakash et al.; Fig. 10B**).

Claim 8 is rejected under 35 U.S.C. 103 as being unpatentable over Prakash et al. (US PGPub 2013/0209954 A1) in view of Charles (US PGPub 2014/0005484 A1).

Regarding claim **8** (Original), **Prakash et al.** teach *the method as claimed in claim 1.*

Although **Prakash et al.** show a rectangular cross-section of the chamber as shown in **Fig. 2B-C, 5B-D, 10A,** but it does not explicitly teach that the *chamber is substantially cylindrical.*

However, **Charles**, in the same field of endeavor **(Abstract)**, teaches *chamber is substantially cylindrical* **(Charles; [0328], L6-9)**.

Before the effective filing date of the claimed invention, it would have been a matter of design choice to a person of ordinary skill in the art to use a cylindrical cross-section of the chamber because Applicant has not disclosed that using a cylindrical cross-section chamber provides an advantage, is used for a particular purpose, or solves a stated problem. One of ordinary skill in the art, furthermore, would have expected Applicant's invention to perform equally well with using a cylindrical cross-section chamber because of mere design choice. Therefore, it would have been a design choice to modify **Prakash et al**'s invention of a dental imaging device to include a dental imaging device as taught by **Charles** to obtain the invention as specified in the claim(s).

Conclusion

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

1. "CHEEK RETRACTOR AND MOBILE DEVICE HOLDER" – Meyer et al., US PGPub 2018/0228359 A1.

2. "IMAGING DEVICE FOR DENTAL INSTRUMENTS AND METHODS FOR INTRA-ORAL VIEWING" – Karazivan et al., US PGPub 2012/0040305 A1.

3. “INTRA-ORAL CAMERA” – Matthews, US Pat 9939714 B1.

4. “METHODS AND APPARATUSES FOR DENTAL IMAGES” – Carrier, Jr. et al., US PGPub 2018/0125610 A1.

5. “SOFT HEAD MOUNTED DISPLAY GOGGLES FOR USE WITH MOBILE COMPUTING DEVICES” – Lyons, US PGPub 2015/0234192 A1.

6. “Dental Informatics and Intra-oral Photography in Communicating with Dental Students in the Dominican Republic” - Lawrence PARRISH, Anton DIY, Nicholas R. KENNING, Kristen TEMPLETON, Ruben SAGUN, Nicole S. KIMMES, Gene GASPARD, Stephen J. HESS; Journal of Health Informatics in Developing Countries; April 30, 2014.

7. “A 3-D Reconstruction System for the Human Jaw Using a Sequence of Optical Images” - Sameh M. Yamany, Aly A. Farag, David Tasman, Allan G. Farman; IEEE TRANSACTIONS ON MEDICAL IMAGING, VOL. 19, NO. 5, MAY 2000.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MAINUL HASAN whose telephone number is (571)272-0422. The examiner can normally be reached on MON-FRI: 10AM-6PM, Alternate FRIDAYS, EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner’s supervisor, JAY PATEL can be reached on (571)272-2988. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/Mainul Hasan/
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